

USED-CAR BUYING SECRETS:

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FOR LESS THAN A CAMRY!

Popular Mechanics

**HOW TO FIX
A HAUNTED
HOUSE**

P.101

PopularMechanics.com November 2011

Science Technology Automotive Home Adventure ★★☆☆

THE 2011
BREAKTHROUGH
AWARDS

20

**BOLD
IDEAS**

The 160 MPG Car
Built by High School Students!



**SPACEX
DRAGON**

The Reusable Capsule Will Carry
Seven Astronauts Into Orbit

NEXT LAUNCH: NOV. 30
DESTINATION: ISS



This Is a Robot
And a Spy Device That Flies Like a Bird



**INNOVATIONS
THAT WILL
SHAPE OUR
FUTURE**



**A Cure for
Paralysis**

"This Procedure Completely
Changed My Life"

**The Tiny
Cell Tower**

It Fits in the Palm of Your Hand!



**Flying
Wind
Turbine**
Harvesting
An Endless
Energy Supply



James Cameron

**Mars
Rovers**
Lifetime
Achievement
Award



3D Film Director,
Engineer, Ocean
Explorer,
Inventor, NASA
Adviser — Oh,
and He's Won
21 Oscars

HEY, CHECK OUT OUR APP, TOO!

IT'S 2011.

SO WHY IS THIS OUR FIRST HYBRID?

It's not a question you'd expect from the world's fourth largest automaker.

Especially when technology like hybrid cars, augmented reality and even jetpacks have been around for years. To some it might imply that we're late to the game. To others, that we're merely following a trend.

At Hyundai, we don't see it that way.

Truth is, we could have followed other car companies and licensed an existing hybrid platform years ago. But making progress is not about following. We wanted to make something better. And, like a lot of people when it comes to hybrids, there were certain perceptions we held, too.

"Hybrids are weird looking."

Most hybrids are designed to be invisible to the wind. But when it comes to style they're also pretty invisible to the eye. We think if you're doing something good by driving a hybrid, you should get to look good, too. So we found a way to work with the design qualities we built into our Sonata to create a coefficient of drag of 0.25, equal to that of the Prius.

"Hybrids are too small."

Achieving greater mileage in a hybrid typically meant giving up interior space to accommodate a bulky battery. We didn't think that was a sacrifice that people should have to make. Then we discovered

a new battery technology that would provide more than a little wiggle room. Lithium polymer properties allow us to shape the battery to the car, not the other way around. And the Sonata Hybrid, with the largest interior in its class, is the first non-plug-in hybrid to feature this technology.

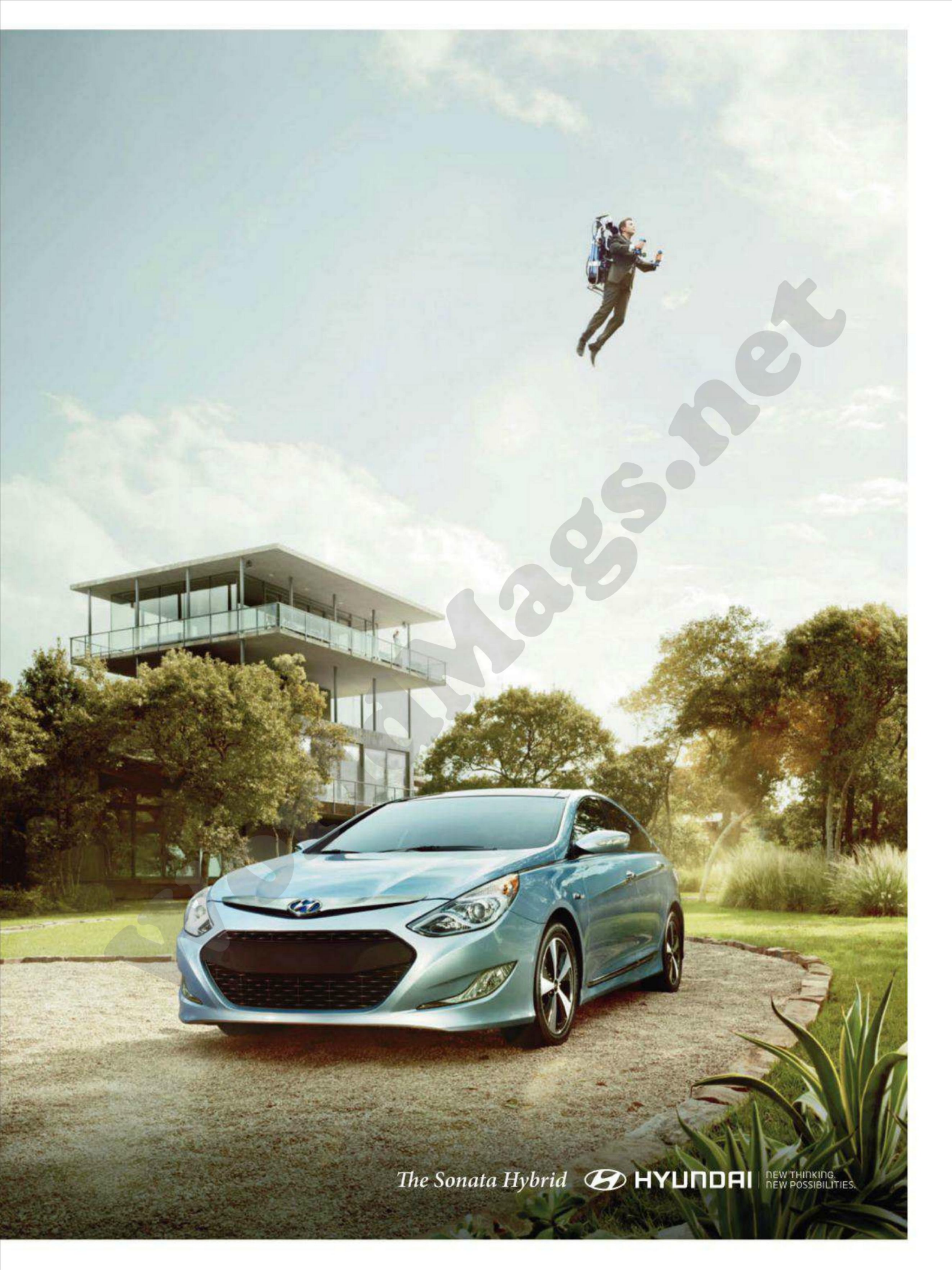
"Hybrids have no guts."

Drive a hybrid and surrender power. Until now, that's been the conventional thinking. But it's hardly a fair trade. That's why every Sonata Hybrid also comes with a class-leading 206 net hp and our proprietary 6-speed automatic transmission to enhance performance. But it's not just a show of strength, considering that the Sonata Hybrid is equally gentle when transitioning from engine-powered to hybrid-drive mode, while also delivering better highway MPG than any other vehicle in its class.

So why is this our first hybrid?

Because we're not ones to jump on a bandwagon, no matter how fuel-efficient it may be. And because technology has caught up to where we can build a hybrid that not only goes beyond what's expected, but is also more like what we've wanted all along: a comfortable, roomier, more stylish car that's also better for the environment. The Sonata Hybrid.

To learn more, visit HyundaiSonata.com



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PopMech
Nov.

Student engineer Morris Bailey works on his team's award-winning biodiesel hybrid kit car.



On
the
cover

54 Breakthrough Awards 2011 We celebrate the year's best and boldest inventions—from a robotic hummingbird to a promising new paralysis treatment—and salute the innovators behind them, including cinema mastermind and explorer James Cameron. **Plus:** Ten revolutionary products available now. **BY LOGAN WARD**

76 Steal This Car (for the Price of a Loaded Camry) These days there's no need to drive a ho-hum econobox. The used-car market is booming, and yesterday's expensive exotic sports car is today's stylish bargain. PM rounds up the best options for your next high-speed purchase. **BY SAM SMITH**

82 PM Lab Test: Mac vs PC Tablets and smartphones have taken center stage, but the long-standing Mac-versus-PC drama rages on. And with new tech and operating systems, both Mac and Windows computers are more powerful than ever. PM puts them through their paces to find the true star. **BY JOHN HERRMAN**

86 72 Hours With just three days to conceptualize, build and complete entries for Red Bull's first-ever Creation challenge, teams from all over the country rolled, pedaled and cranked their best DIY contraptions into action. PM senior editor Glenn Derene and a panel of judges picked the winner. **BY MARY BETH GRIGGS**

Launched atop a Falcon 9 rocket, the SpaceX Dragon capsule is designed to carry seven astronauts. SpaceX hopes to dock Dragon with the International Space Station this month. **Rocket and capsule illustration by Vladimir Shelest. Icons by Dogo.**

Tech Watch

15 What Lies Beneath An eruption among undersea volcanoes in the South Atlantic could create new islands. **Plus:** Improving the Chinook helicopter's defense system; what NASA can learn from a spacecraft that crashed on the moon 44 years ago.

Upgrade

27 Buzz Killer A random-orbit sander that won't vibrate your fingers into numbness. **Plus:** Fall-leaf-cleanup tools and tips; a history of the hexhead; a ceramic knife blade that cuts like a scalpel; 10 new gadgets you need to know about this month.

New Cars

37 Buick's BMW With an upgraded suspension, larger front brakes and a 270-hp turbo engine, the 2012 Buick Regal GS feels more Bavarian than American—but in all the right ways. **Plus:** The 2012 Porsche Cayman R makes a strong argument for "less is more."



Does your floor creak like it belongs in a horror movie? PM's squeaky-floor fixers can silence that problem.

Doors open or shut themselves. Lights flicker randomly. A toilet flushes on its own. When things go bump in the night, we reach for our toolbox and get to work.
—DIY Home, "The Telltale House," page 101

Column

50 Brand Anew With Halibrand wheels and Stromberg carburetors making a comeback, Jay Leno celebrates the rebirth of classic American auto parts brands.

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PopMech
diy

Tech

91 Vintage Audio in the Digital Age Dust off your old receiver: Classic audio gear finds new life today.

96 Digital Clinic Improve the timing of your tech purchases. **Plus:** Undoing accidental app downloads; are your Twitter followers real people?



Home

101 The Telltale House Flickering lights? Random toilet flushes? It *could* be that your house is haunted. On the other hand, the solution may lie in your toolbox.

106 Homeowners Clinic Quick bathroom upgrades, including a new wall sink. **Plus:** How to lower your heating bill this fall.

110 PM Saturday Our DIY leaf-sack rack makes lawn cleanup a snap—and lets you get back to watching the ballgame.



Auto

113 How to Inspect a Used Car Buying preowned wheels can be a gamble; our 101-point inspection checklist shifts the odds in your favor.

118 Car Clinic Replacing a faulty oxygen sensor. **Plus:** Why your car smells like rotten eggs; snuffing out a stubborn Check Engine light; how to diagnose a bad starter.



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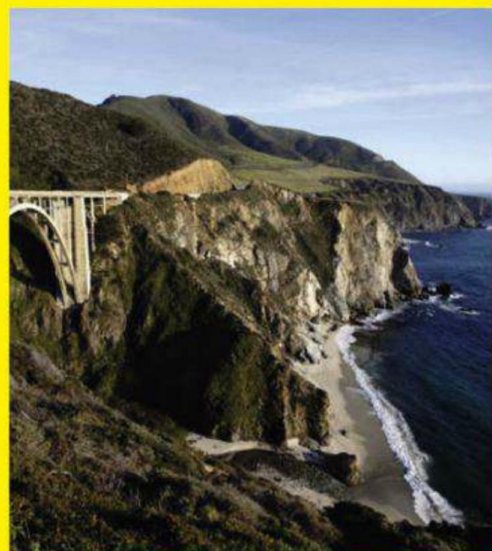


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HOT HATCHBACKS Three- and five-door hot hatchbacks—great driver's cars disguised by a cloak of practicality—are on the rise in the United States. We can't wait to get behind the wheels of these five.
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Chevy Runs Deep

PM BREAKTHROUGH
AWARDS UPDATECatching Up With
Jeff HanFOUNDER,
PERCEPTIVE PIXEL

Jeff Han has been helping define the capabilities of multitouch technology since before the release of the Apple iPhone. He won a 2007 Breakthrough Award for his supesize screen, which measured 103 inches. This August, the founder of Perceptive Pixel released a thinner, 82-inch version. — ALLIE HAAKE

PM: Your screens are already used by companies, including CNN. Why redesign a successful product?

JH: The technology served us well; the problem was that the screen required a projector behind it a few feet deep. It was pretty big and bulky.

PM: Your new screen is larger than others of its kind on the market.

What's the primary technical challenge to going bigger?

JH: At this size, electromagnetic noise interferes with the touch sensor. We've developed algorithms that extract signal from noise, much like how radar works. The hardware part of radar makes the radio wave and receives it, but the magic is, once you receive the signal, how do you interpret it?

PM: With iPhones everywhere, what place does a large-size multitouch screen have in the marketplace?

JH: Large displays allow you to collaborate, the same way a notebook lets you take notes for yourself and a whiteboard lets people work together. This company isn't about multitouch—it's about multiuser.

For more, visit popularmechanics.com/jeffhaninterview.

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Pilot Joe Matthews of Grand Rapids, Mich., always keeps his eye on the sky and his instruments—unless his autopilot, George, is flying. Recently, Matthews checked out PM on his iPad as he climbed to 10,000 feet above Lake Michigan in his Cirrus SR22 Turbo. “I read every issue,” he says.

How Many CFLs Does It Take . . .

I enjoyed “The Light Bulb Wars,” your September article explaining how new efficiency regulations banning incandescent bulbs will affect us. In winter, I use a tiny 7-watt incandescent light to confirm that the electricity is on in my summer home. It works in all temperatures. What am I going to do when this incandescent is no longer available? Also, as long as it requires a special trip to recycle a CFL bulb, most will be trashed. Just the way the world works.

FREDERICK S. HOLMES JR. ANNANDALE, VA

I read your article about the light-bulb ban with great interest. I was an early supporter of CFL bulbs, seeing cost- and energy-saving potential. The truth is, there are issues with them. They have outrageous bulb-life claims and, frankly, the dimming ones don't work. Period.

JAY O'BRIEN VISTA, CA

EDITOR'S NOTE: While the new regulations prohibit the sale of many incandescent bulbs, most specialty lamps—including your 7-watt night light—are exempt from

completely natural to transfer over to the standby instruments. When those failed, the captain and I completed an uneventful landing with no instrumentation whatsoever. Yes, technology integrated into flight systems increases situational awareness and relieves pilot workload. But all professional pilots I know recognize it as but a tool to assist, not the means by which a flight is conducted. Just ask Sully. History may one day judge the pilots of AF 447 as guilty of not saving the airplane, but, for now, let's give them the benefit of the doubt. We may truly find that the aircraft was not reasonably recover-

the rules. You have a good point on the disposal issue—many people aren't even aware of nearby disposal centers, and making a special trip may be too much effort for others. Sorry to say, dimmable CFLs don't work with fixtures made for incandescents. And new fixtures can be pricey.

JOHN HERRMAN ASSISTANT EDITOR, POPULAR MECHANICS

Ultimate Flying Tech: The Pilot

As the flying pilot on the A320 flight that experienced a near-total electrical failure after takeoff from Newark Liberty International Airport in 2008, I feel compelled to respond to “Flight Risks” (August), your article about the wreckage of Air France Flight 447 and the general safety of automated cockpits. Yes, the A320 I was piloting essentially had a complete electrical failure, but it did not result in any kind of mishap. In fact, I found it

From our fans
and followers

Hello, PM readers on Facebook and Twitter—and thank you for responding to our stories. Here are some recent comments.

This is absolutely amazing! I can't wait for stylus features to be added. The drafting and design possibilities are endless!
RYAN GUILLORY, VIA FACEBOOK (“How Jeff Han Created the World-Record 82-Inch Multitouch LCD,” *popularmechanics.com*)

@PopMech was right. The new Jeep Wrangler will be great. But it needs a diesel. Please

offer one! You won't be sorry!
@SEANENGARD, VIA TWITTER (“2012 Jeep Wrangler Test Drive,” *popularmechanics.com*)

In response to “Five Ways Apple Might Become a Better Company Without Steve Jobs,” on the PM site:

Maybe they'll get along with Adobe too? We iPhone users could use Flash support!
DAN GRAVEEN, VIA FACEBOOK

Apple changing strategy is like Coke coming out with a new Coke. Idiotic!
ERIK HUYGHE, VIA FACEBOOK

What
do you
think?

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DOUG COCHRAN BROOMFIELD, CO

Fracking Facts

As a Halliburton employee on the Marcellus Formation, I'd like to thank you for your particularly accurate and balanced article exploring common claims about the natural-gas-collection process known as fracking ("Drilling Down," September). While I'm not in the fracking division, I work closely with it. It's not a process that most people understand or can easily imagine, and it seems like all the news reports focus on the bad stories. Fracking's not perfect, and sometimes things go wrong (like the Chesapeake spill), but as much as I'm a fan of solar, wind and geothermal, our infrastructure and society just aren't ready to drop hydrocarbons cold turkey. So, we must do the best we can. Thanks for showing both sides of the story.

A. JORDAN INDIANA, PA

Area 51 Atomic Bomb Tests

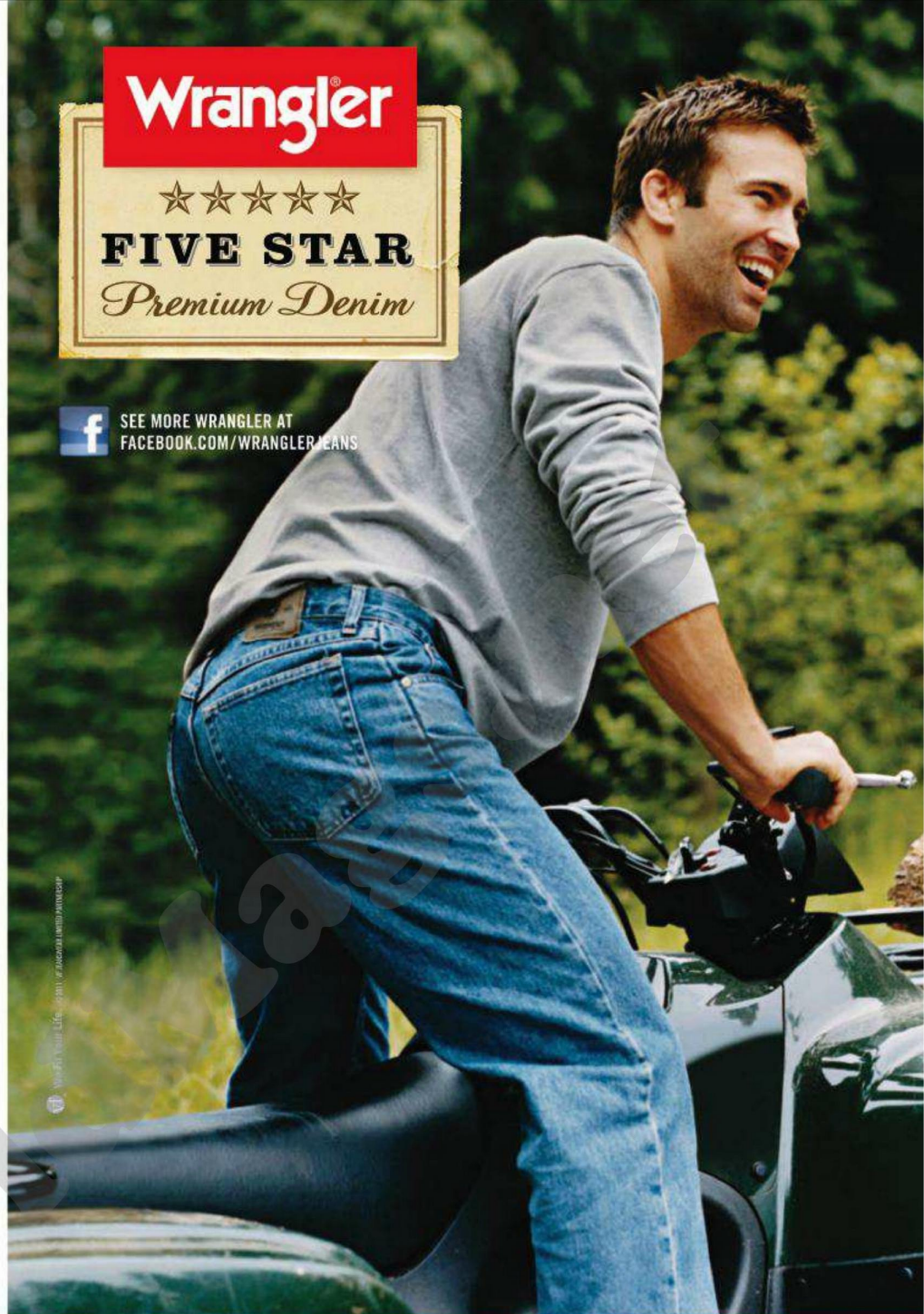
Nicely done on your story questioning the validity of a new book on Area 51's true history ("What Really Happened in Area 51," September). The book's author said atomic bomb tests in Nevada during the 1950s were kept hidden from the public by the government. I was a boy in the Mojave Desert during that time, and the existence of these tests was far from secret. They were written about in the area newspapers, and my parents used to wake me up well before dawn to stand on the porch and watch the flash of the nuclear detonation, 100 miles east. As your article points out, there are even more problems with the author's other extraordinary claims. Seems there was a significant lack of in-depth research and intellectual reasoning that went into the writing of this book.

J.L. MATTHEWS DENTON, TX

CORRECTION: In September's "How Your House Works: Backyard Boardwalk," the fastener identified as a 1/2-inch galvanized lag bolt should have been labeled as a carriage, or ledger, bolt.



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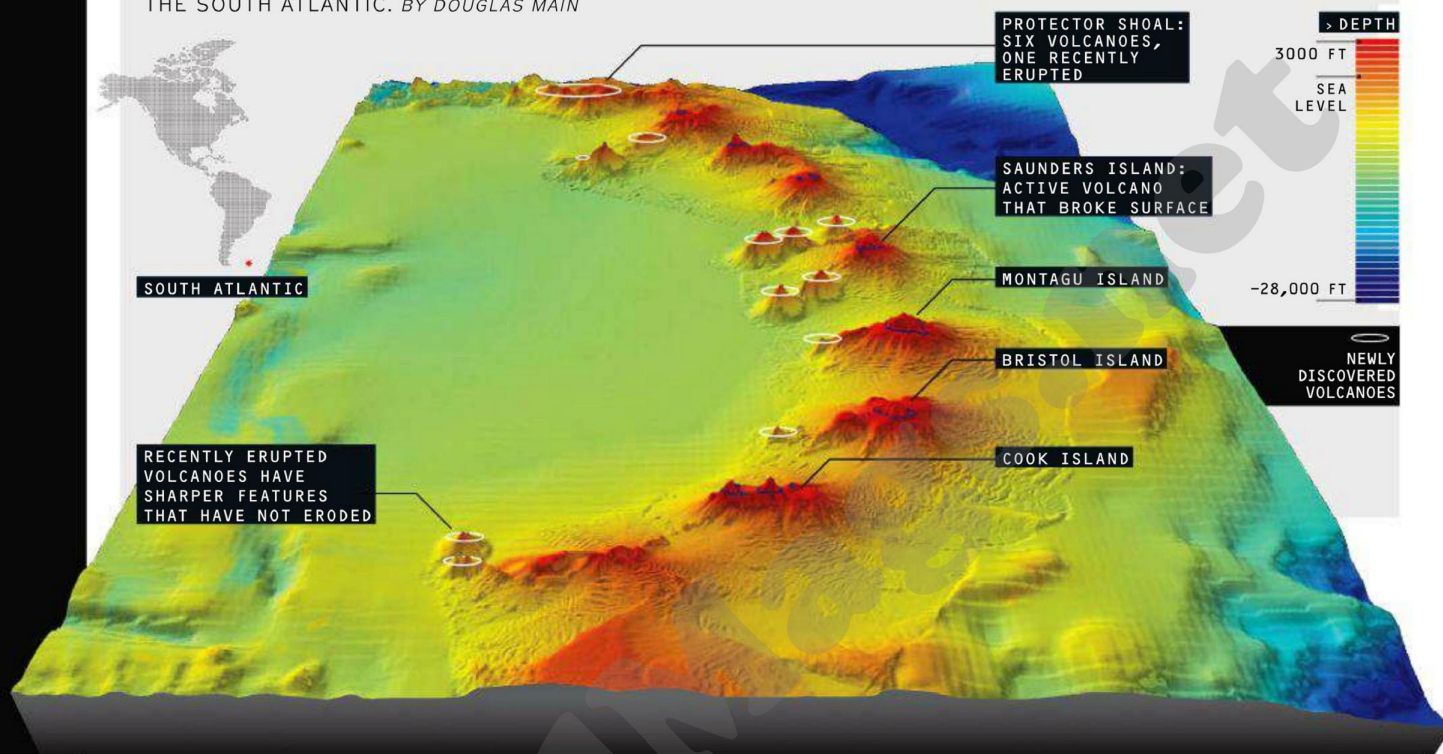




• EARTH SCIENCE

Earth's Subsea Peaks

NEW SCANS SHOW A VOLCANIC RANGE LURKING BENEATH THE SURFACE OF THE SOUTH ATLANTIC. BY DOUGLAS MAIN



➔ Scientists have found underwater volcanoes—some up to 2 miles tall and showing evidence of recent eruptions—in the remote South Atlantic. Researchers working with the British Antarctic Survey generated 3D images of the seafloor with multibeam sonar. Expedition leader Phil Leat says one volcano's summit lurks just 160 feet below the surface and that it could form an island if it erupts. Leat plans to return soon to catalog marine life; new species have been found nearby. "There are countless discoveries waiting to be made," he says.

• QUICK HITS



BRAIN BRAKING

➔ When a driver slams on the brakes, there's a lag between the decision to stop and the foot's reaction. Neuroscientists at the Berlin Institute of Technology are trying to reduce that delay. With electrodes attached to their scalp and legs to measure synaptic and muscular triggers, drivers in a simulator

braked 130 milliseconds faster than their feet could press the pedal. That equates to 12 feet at about 60 mph, enough to avoid a collision.



FUNCTIONAL TATTOOS

➔ Researchers at Northeastern

University in Boston have developed an injectable "tattoo" that monitors the body. The invisible mark contains sensors that glow when a certain molecule is detected; a filter on a cellphone camera enables users to see the mark. Early applications could include noninvasive blood-sugar monitoring for diabetics.



ROBOTIC BAKER ➔ The quest for a kinder, gentler robot took a step forward when MIT's BakeBot successfully made a giant chocolate cookie from scratch. What sounds like a simple task for humans actually requires sophisticated hierarchical planning by the robot's designers, and impressive dexterity to assemble the ingredients, cream the butter and sugar, and shape the dough. Using a PR2 robot from California-based Willow Garage, researchers programmed BakeBot to use laser and stereo cameras to locate and identify the ingredients.

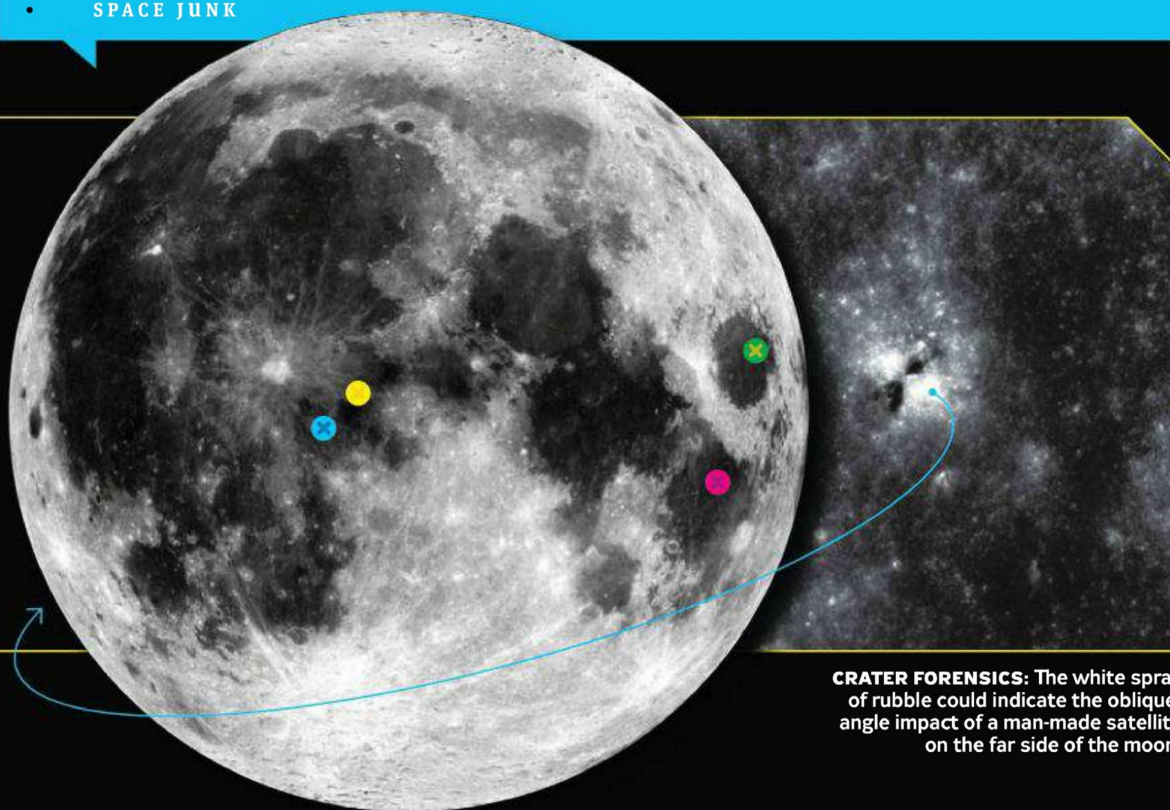
—ALEX HUTCHINSON

Lunar Lost and Found

AN ORBITER LOCATES THE SUSPECTED RESTING PLACE OF A PROBE THAT CRASHED ON THE MOON 44 YEARS AGO. **BY LESTER BLACK**

NASA's Lunar Reconnaissance Orbiter Camera (LROC) is taking the highest-resolution images of the moon's surface from space, scouting locations for future astronaut or robot landings. But LROC may also have discovered the resting place of Lunar Orbiter 2, a NASA spacecraft that disappeared on the far side of the moon in 1967. Orbiter 2 was in an intentional death dive, but NASA never knew the site of its impact. The debris from an impact angle of 45 degrees or more spreads out like butterfly wings, says LROC science operations center manager Ernest Bowman-Cisneros. While losing equipment is unavoidable, examining its crash sites is useful. "They are great laboratories for studying small impacts on the moon," Mark Robinson, LROC's principal investigator, says.

SPACE JUNK



CRATER FORENSICS: The white spray of rubble could indicate the oblique-angle impact of a man-made satellite on the far side of the moon.

NOTABLE LUNAR CRASHES

✕ APOLLO 14

Country: U.S.
Launch: Jan. 31, 1971
Crash: Feb. 4, 1971

INTENTIONAL

The upper stage of Apollo 14's Saturn IVB rocket creates a 115-foot-wide crater and causes a moonquake that reveals seismic details about the lunar interior.

✕ SURVEYOR 2

Country: U.S.
Launch: Sept. 20, 1966
Crash: Sept. 22, 1966

UNINTENTIONAL

The soft touchdown is supposed to aid the Apollo program, but the spacecraft crashes when one of three thrusters fails to ignite.

✕ LUNA 15

Country: U.S.S.R.
Launch: July 13, 1969
Crash: July 21, 1969

UNINTENTIONAL

The main retrorocket of this lander, used in the Soviets' second attempt to bring moon rocks back to Earth, fails to fire.

✕ CHANG'E 1

Country: China
Launch: Oct. 24, 2007
Crash: March 1, 2009

INTENTIONAL

The first Chinese robotic lunar mission transmits 175 gigabytes of information before it plummets to the surface.

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The one. The 34 mpg hwy Accord.



accord.honda.com 1-800-33-Honda †Honda Accord received the lowest number of problems per 100 vehicles among midsize cars in the proprietary J.D. Power and Associates 2011 Initial Quality Study.™ Study based on responses from 73,790 new-vehicle owners, measuring 234 models and measures opinions after 90 days of ownership. Proprietary study results are based on experiences and perceptions of owners surveyed in February – May 2011. Your experiences may vary. Visit jdpower.com. *23 city/34 hwy/27 combined 2012 EPA mileage estimates for Accord 4-cylinder Sedan models. Use for comparison purposes only. Actual mileage will vary. ©2011 American Honda Motor Co., Inc.

MODERN WARFARE

Flight Risk

CHINOOK HELICOPTERS ARE KEY TO THE U.S. EFFORT IN AFGHANISTAN. AFTER A TRAGIC INCIDENT THIS SUMMER, THE ARMY HOPES TO MAKE THEM LESS VULNERABLE. BY SHARON WEINBERGER

ELECTRO-OPTICAL MISSILE SENSORS (EOMS) CAN DETECT ENERGY EMITTED BY AN INCOMING MISSILE'S PLUME.



The nation was horrified when Taliban forces used an unguided rocket-propelled grenade (RPG) to shoot down a CH-47 Chinook in August, killing 38 people. The attack highlighted a defensive flaw in U.S. Army helicopters: While they're capable of warding off sophisticated weapons, such as guided missiles, the helos are still susceptible to low-tech attacks from RPGs or small-arms fire.

GUIDED WEAPONS

Chinooks in Afghanistan have the Common Missile Warning System, which detects radar- or infrared-guided missiles and spoofs them with chaff (bits of fluttering metal) and flares. The Army plans to finish installing an improved system—the Advanced Threat Infrared Countermeasures Quick Reaction Capability—on all the helicopters deployed in combat areas by the end of this year. The new hardware employs a laser to jam infrared-guided targeting systems.

UNGUIDED WEAPONS

Hostile Fire Quick Reaction Capability alerts pilots to an incoming warhead so they can maneuver out of its way; the system is due for installation on Army helicopters later this year. But the more advanced Hostile Fire Detection System—which tells pilots the direction of inbound, unguided rockets by quadrant and clock position—is facing delays. The Pentagon postponed a June meeting to consider buying the system, saying the Army and industry did not have enough information.

ENERGY HARVESTING

Ball of Power

→ The sOccket soccer ball, which generates electricity with each kick, is going global.

Co-developed by four Harvard graduates, about 10,000 units of the 2010 PM Breakthrough Award-winning invention will be distributed to electricity-poor communities worldwide by the end of 2011, and a limited number will be for sale on sOccket.com.

The production version delivers 10 times as much juice as the original did by replacing a built-in, bidirectional shake-to-charge device with gyroscopic technology.

"Instead of just capturing energy from one dimension of motion, it's capturing energy from all possible dimensions," co-developer Julia Silverman says. "The prototype could power an LED lamp; the new ball can handle multiple LEDs and a water purifier."

— ALLIE HAAKE





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Atacama Day Date No. 1824: 42mm, gunmetal PVD plated stainless steel case with screw case back and screw-down crown, antireflective sapphire crystal, water resistant to 200 meters, gunmetal PVD plated solid link steel bracelet with security clasp, and Luminox self-powered illumination. Swiss Made. Preferred timepiece of outdoor enthusiasts. Luminox.com

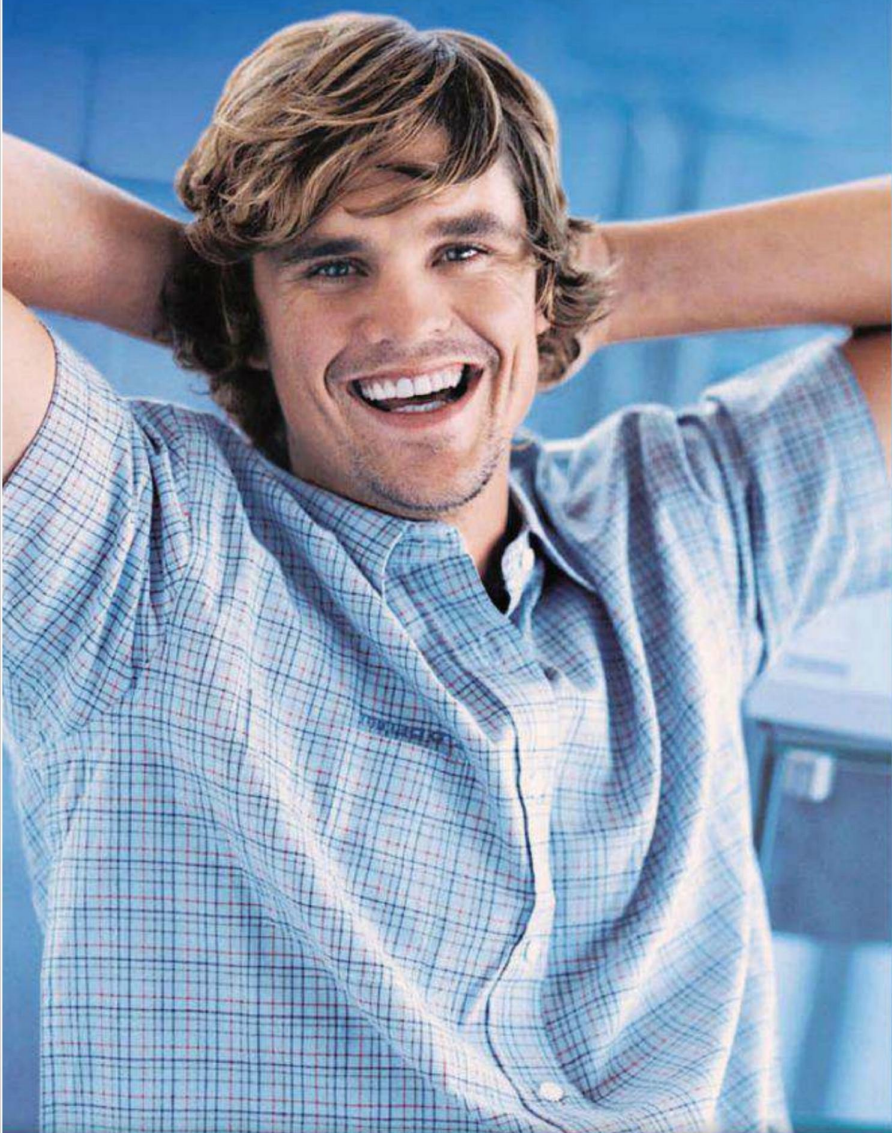


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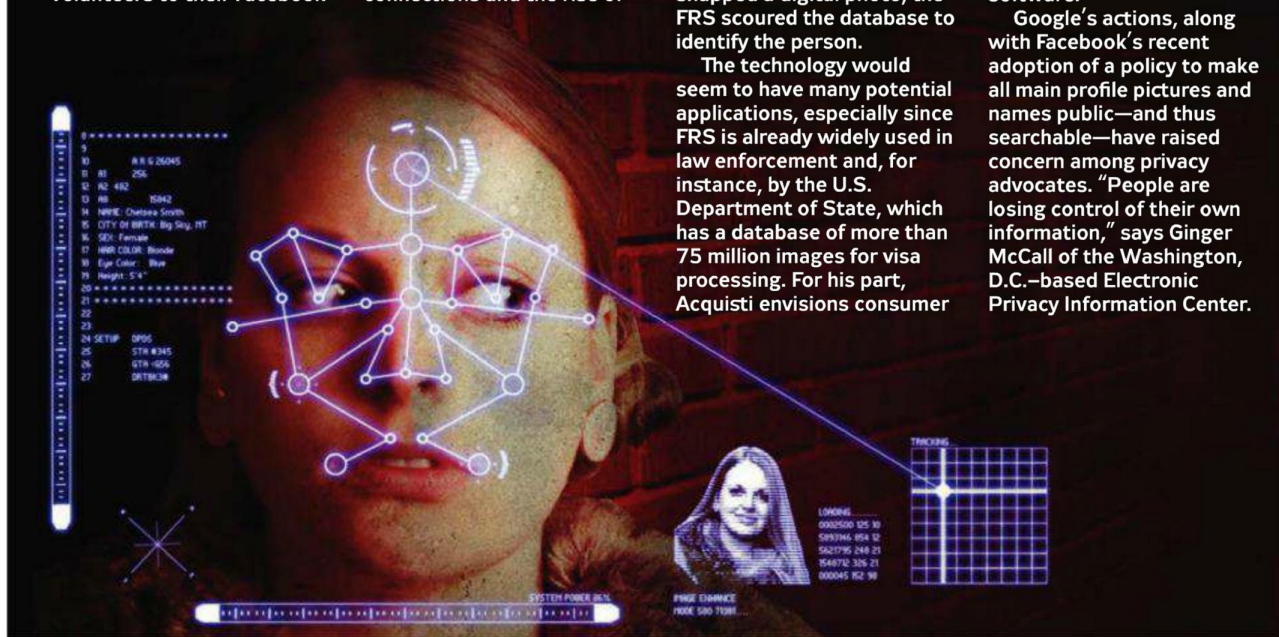
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WILL HARNESSING IDENTITY-RECOGNITION SOFTWARE TO SEARCH ENGINES FURTHER ERODE PRIVACY? BY MARY BETH GRIGGS

Google's actions, along with Facebook's recent adoption of a policy to make all main profile pictures and names public—and thus searchable—have raised concern among privacy advocates. "People are losing control of their own information," says Ginger McCall of the Washington, D.C.-based Electronic Privacy Information Center.



•

The image displays four figures representing the evolution of body armor over time, arranged horizontally from left to right. Each figure is shown from the waist up, standing against a plain white background. Below each figure is a black rectangular box containing the year, followed by the name of the armor and its weight in pounds.

- 1470:** A figure in full plate armor, including a helmet with a visor, a breastplate, and gauntlets. The armor is dark grey and highly reflective. The figure holds a sword in the right hand.
- 1943:** A figure wearing a green flak jacket with two large pockets on the chest and dark gloves. The figure is wearing dark boots.
- 2007:** A figure wearing a green tactical vest with horizontal stripes and a helmet. The figure is wearing dark boots.
- 2010:** A figure wearing a yellow modular body armor vest with multiple pockets and a helmet. The figure is wearing dark boots.

Year	Armor Type	Weight (pounds)
1470	British knight's armor	77
1943	U.S. Air Force flak jacket	25
2007	U.S. Army Improved Outer Tactical Vest	33
2010	U.S. Special Forces Modular Body Armor Vest	16

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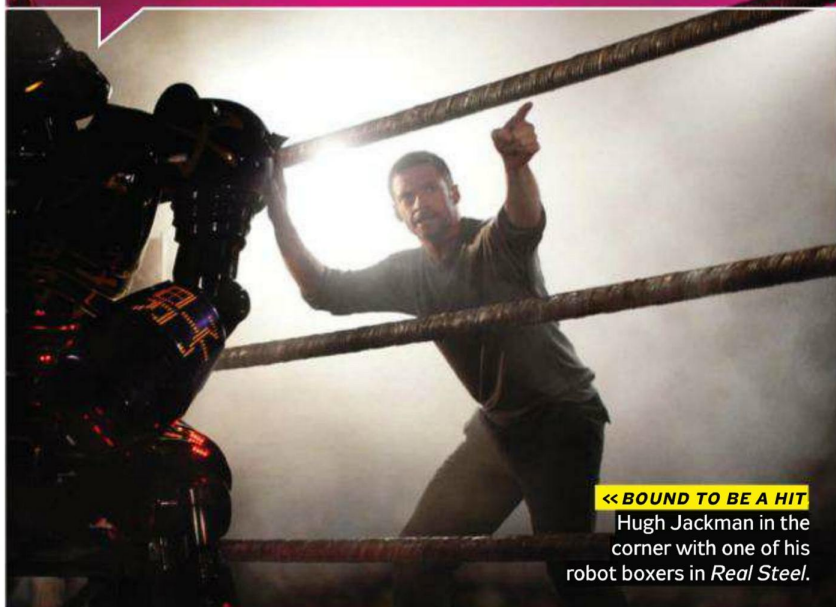


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HOLLYWOOD FACT VS FICTION



<< BOUND TO BE A HIT
Hugh Jackman in the
corner with one of his
robot boxers in *Real Steel*.

Rock 'Em, Sock 'Em

Hugh Jackman wonders if future robots will be able to box the way they do in his current movie.

When **POPULAR MECHANICS** visited the set of *Real Steel*—which takes place in a not-too-distant future where robots face off in the boxing ring—leading man Hugh Jackman asked us, “Will robots really be this advanced in 10 years?” We had a partial answer: The film, out Oct. 7, touches on current and developing robot technologies, but bot boxing would require major advances. Still, Jackman’s curiosity prompted us to dig deeper.

Real Steel’s bots fight with human motor skills and even adapt to their opponents’ moves. According to Drew Bagnell, an associate professor at Carnegie Mellon University’s Robotics Institute, researchers are currently studying robotic balance and fluid movement. The University of Michigan’s biped robot MABEL, for example, can run 6.8 mph and keep its balance while reacting to its environment.

In *Real Steel*, bot boxer Atom learns to spar by mimicking Jackman’s movements. Something similar is

occurring in real life. “We got the best performance out of DARPA’s Crusher robot when a human showed it how to drive,” Bagnell says. “It learned to associate sensor readings with things

people avoid and things they drive over; that made it able to drive in places it had never visited before. What happens in *Real Steel* is [easier], because the robot is mimicking simple trajectories.” Another bot, Zeus, studies the fight styles of its foes and figures out how to defeat them, giving Zeus the advantage.

What *Real Steel* gets wrong, Bagnell says, is the remote control. Operators in the film use fight decks to pilot the robots, but most state-of-the-art bots are autonomous. “People give them a task, and they figure out how to do it,” he says. “For a boxing robot, you’d need some level of autonomy—a person couldn’t control every joint at once.” Though sparring robots may seem far-fetched now, “10 years is a long time,” Bagnell says. “Nothing in the film seems wildly unreasonable.”

So, there’s your answer, Hugh. (You don’t mind if we call you Hugh, do you?) We’re glad you asked.

— ERIN MCCARTHY

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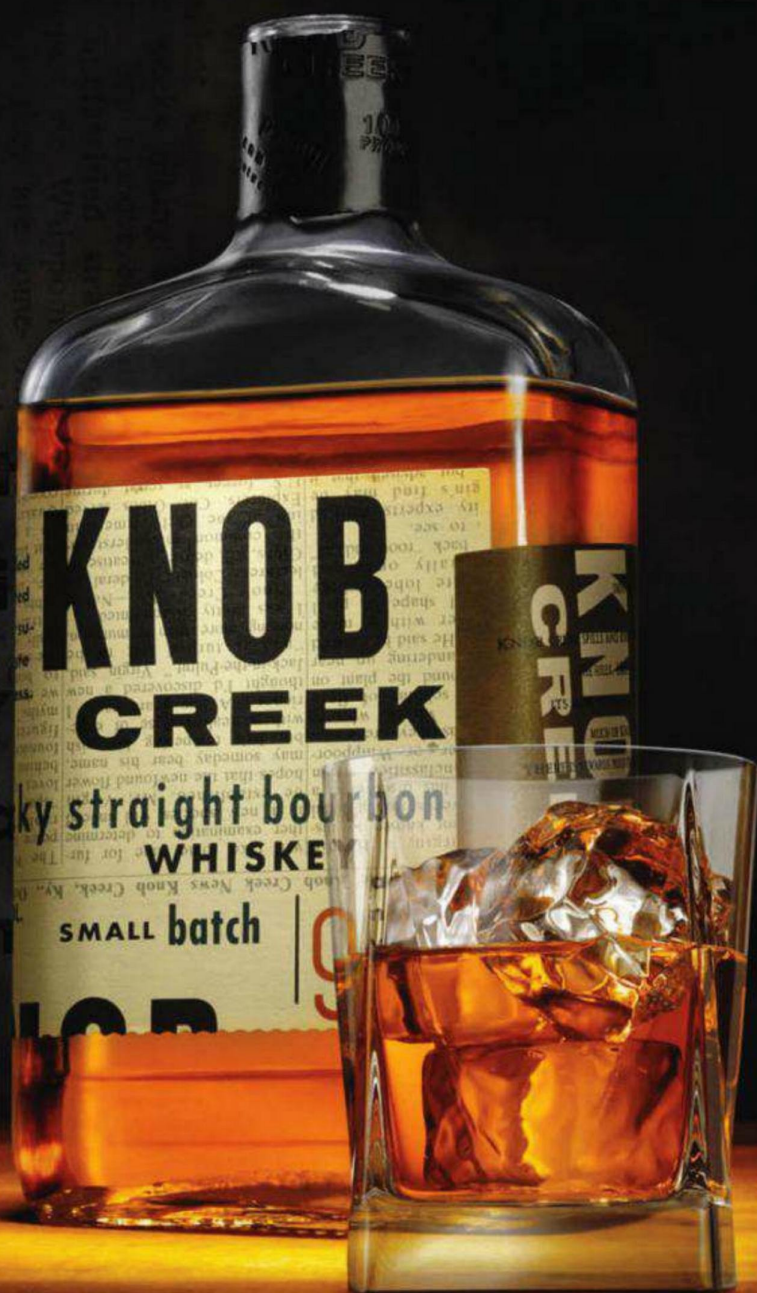
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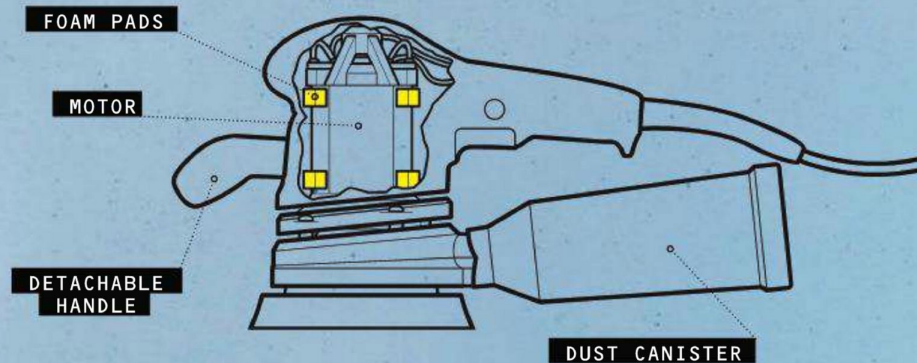
Buzz Killer

Vibrating tools can cause tingling and numbness in the fingertips after extended use.

Bosch's new ROS65VC random-orbit sander (\$229)

offers relief from this white-knuckle suffering. Eight vibration-damping foam pads isolate the sanding disc from the handle, so the only connection between the business end and the trigger, besides the foam, is the electrical wiring. Multiple grip configurations allow the user to switch hand positions to minimize fatigue, and the protruding front handle can be removed to place the tool flush against an interior corner. To solve yet another typical sander shortcoming, Bosch designed the machine to accept either 5- or 6-inch-diameter sanding sheets. You'll have to find your own way to perfectly line up the paper and the pad's little holes. Funny thing, but that task turns out to be much easier when you can actually feel your fingertips.

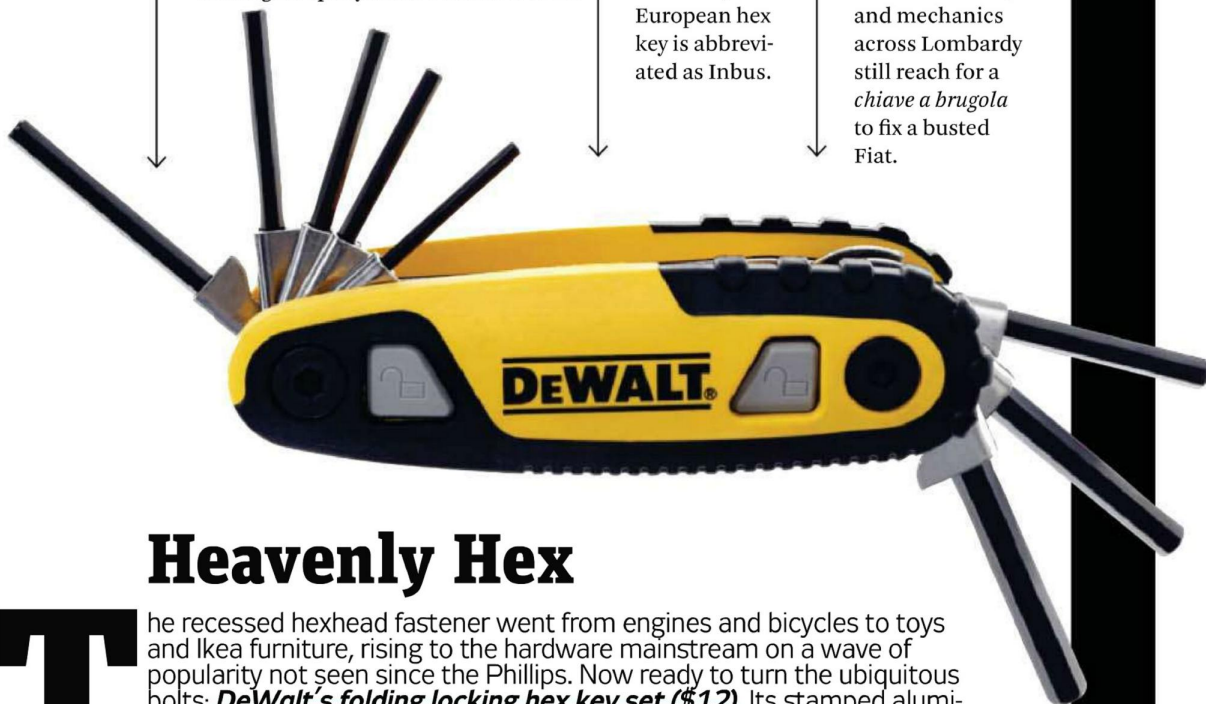
— HARRY SAWYERS



UNBRAKO; ALLEN (*United States*)
Invented in 1911 by Standard Pressed Steel (SPS) of Philadelphia and sold as an Unbrako key, the first hex key was in such demand during WWII that SPS rival Allen Manufacturing began making its eponymous wrench in 1943.

INBUS (*Germany*)
Patented in 1936 in Germany by Innensechskantschraube Bauer und Schaurte, the European hex key is abbreviated as Inbus.

BRUGOLA (*Italy*)
Egidio Brugola imported the hexhead screw and key to the northern town of Lissone in 1926, and mechanics across Lombardy still reach for a *chiave a brugola* to fix a busted Fiat.



Heavenly Hex

The recessed hexhead fastener went from engines and bicycles to toys and Ikea furniture, rising to the hardware mainstream on a wave of popularity not seen since the Phillips. Now ready to turn the ubiquitous bolts: **DeWalt's folding locking hex key set (\$12)**. Its stamped aluminum rod holds eight six-sided bars in rigid, slop-free settings. Considering that the typical hex key is an L-shaped sliver of palm-gouging metal, this tool adds a big improvement over the standard—a handle.

RAZOR BUMPS

◀ The tiny ridges on the cutting edge of **Kyocera's Micro-Serrated Knife (\$62)** are 0.95 mm apart, making the ceramic blade a super-precise slicer. We shaved tomatoes into translucent discs and carved a whole-grain loaf into playing-card-thin toast.

RIDING SHOTGUN

▶ To navigate the virtual apocalypse of **id Software's Rage (\$60)**, PS3, PC and Xbox players race through a wasteland to earn vehicle upgrades. Spiked wheels, bayonets, armor, roof-mounted rocket launchers and Gatling guns (along with prosaic suspension, engine and tire work) create the fierce Cuprino road warrior.



PRETTY STICKY

▶ Rob Jordan doesn't mince words when speaking of his firm's **Platypus Designer Duct Tape (\$8)**: "I love duct tape," he says. Jordan turned his passion into a dozen styles, such as denim, diamond plate, polka dots and houndstooth. Clients use rolls to dress up guitar picks, beer cozies, ties and wallets.



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Foliage Fighters:

How to Beat the Leaves

→ Whether you bag 'em or burn 'em, you have to get scattered debris into an orderly heap. Here's the latest in leaf management. **BY HARRY SAWYERS**



SUPER TARP

→ It takes only six or seven rounds of filling up the 8 x 8-foot **Leaf Lugger (\$50)** for Steven Costello, this tarp's designer, to clear out his 1-acre lot in Pennsylvania. The nylon-mesh sides cinch up via an internal rope to haul up to 100 pounds. "That would be a load of very wet leaves," Costello says.



SPRUCE SPORKS

→ After cutting flat edges into a pair of garbage can lids, the late Matthew Check was well on the way to inventing his **Leaf Scoops (\$7 a pair)**. The eureka moment came when he carved teeth in the flat faces. "Then they could even pick up small objects, like acorns," distributor Bill Keller says.

THE JOY OF RAKING

→ Designed by a 6-foot-7 man who has modified just about everything to fit his height, the **Snake Rake (\$40)** uses offset handles to save a raker's back. A clip pivots the grips from a right-handed to a southpaw stroke, and pins adjust the length. The designer, Weston Hinden, gives away his light aluminum tools to any neighbors he finds raking. "He just has a knack for making things better," Hinden's wife, Lori, says.

MOVE IT OR MULCH IT

→ Worx product manager Joe Ferris admits the **TriVac WG500 (\$80)** isn't a category-leading blower, leaf vacuum or mulcher—but it effectively combines all three. A switch flips the tool from blower to vac mode, and the same impeller that moves the air chews up the leaves. An optional hose sends mulch straight to a trash can.



OUTSMART AUTUMN

Follow advice from Virginia Tech turf specialist Mike Goatley to make the most of deciduous detritus.

Don't Ignore 'Em

A thick layer of leaves blocks sunlight from grass, trapping moisture in the turf canopy and increasing the potential for disease. You have to get rid of them. Sorry.

Manage the Mulch

Mulching leaves directly into grass saves time and adds nourishing carbon to the soil. Clear the lawn of sticks, which damage a mulching mower, and work in dry weather. "Mulching moist leaves minimizes dust, but wet leaves clump," Goatley says. "The mower can't chop them into small pieces that easily decompose." Wear a dust mask, clean the air filter and make multiple passes with the mower.

Separate the Straw

Pine needles are slow to degrade and also raise soil acidity. Use dried straw as bedding beneath shrubs—but keep it off the grass.

Bag the Easy Way

If your town requires leaves to be bagged, lighten the workload with PM's leaf-sack rack (see plans, page 110).

The Tech-O-Meter

→ New gadgets hit the market at such a fast pace that they can become a blur. Here we present 10 items worth focusing on, for better or worse. **BY JOHN HERRMAN**



DROID BIONIC

Motorola's latest is the fastest phone (for now). Its 15-Mbps connection on LTE 4G downloads at 10 times the speed of 3G. (\$300, est.)

EARTHSHAKING

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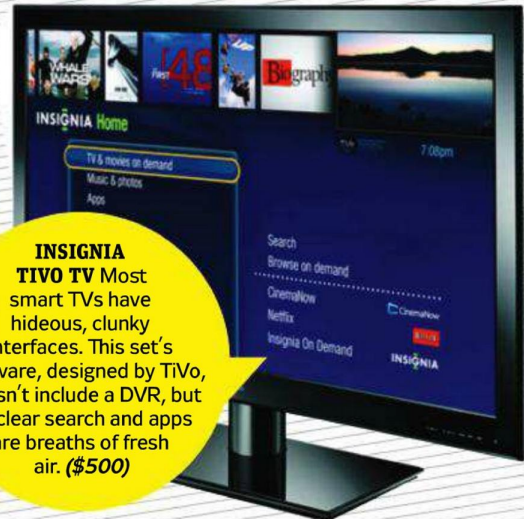
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INSIGNIFICANT



INSIGNIA TIVO TV

Most smart TVs have hideous, clunky interfaces. This set's software, designed by TiVo, doesn't include a DVR, but its clear search and apps are breaths of fresh air. (\$500)

SONY TABLET S Android tablets are dying of sameness. Sony's solution: a classy asymmetric body, built-in universal remote and Chumby widgets. (\$500)

WACOM BAMBOO CAPTURE A

A \$100 pressure-sensitive drawing tablet from the company that makes some of the best digital art tools. The killer feature: It also works as a multitouch trackpad. Pinch, twist and flick to your fingers' content. (\$100)

REDBOX GAMES The supermarket movie-rental-kiosk company that helped kill Blockbuster is rolling out game rentals to almost all of its boxes. Watch your back, GameSpot. (\$2)

ADOBE EDGE Tired of slow, buggy, crash-prone Flash plug-ins? Gosh, so are we. With Edge, a tool for making content in HTML5, Adobe has finally accepted the grim fate of Flash. (free)

GRIFFIN STOMPBOX

With the iShred app, an iPad or iPhone becomes a wildly capable multieffect guitar processor. Griffin's pedal brings that power to the stage. (\$99)



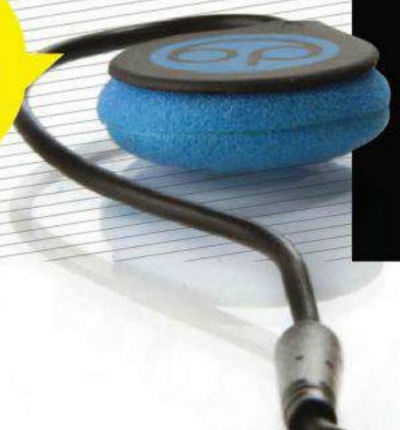
TOSHIBA QOSMIO F750

A 3D laptop that doesn't require glasses. Seeing 2D and 3D videos running side by side on the same screen is awesome. Not so awesome: lack of support for 3D games and a pesky price. (\$1900)

HP PRE3 This phone, the first truly major update to the Palm Pre, was supposed to be the savior of the handset division HP acquired from Palm. Then HP abruptly shuttered its phone and tablet programs. The doomed Pre3 may be the last webOS phone ever. RIP, sweet Pre. (not for sale)

BEDPHONES

These comfy, flat, pillow-safe earbuds are a small invention, sure, but also a wonderful one. (\$30)



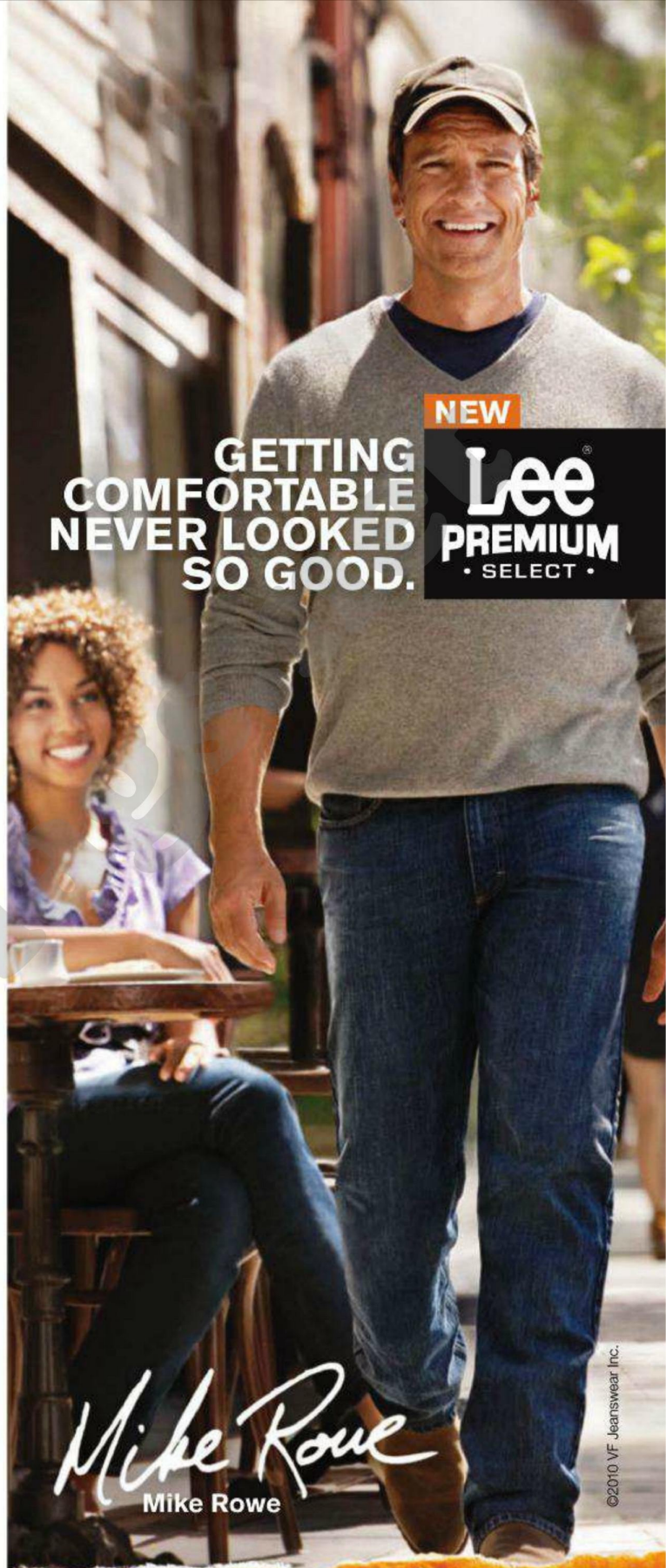
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and for more information about PRADAXA call 1-877-PRADAXA or visit pradaxa.com.



**Boehringer
Ingelheim**

*Here's why you should ask your doctor about **PRADAXA**.*

- In a clinical trial, PRADAXA 150 mg **reduced stroke risk 35% more than warfarin.**
Risk reduction was greatest when compared to patients on warfarin whose blood tests showed lower levels of control.
- **Unlike warfarin, no regular blood tests.**

PRADAXA is a prescription blood-thinning medicine used to reduce the risk of stroke and blood clots in people with atrial fibrillation not caused by a heart valve problem. With atrial fibrillation, part of the heart does not beat the way it should. This can cause blood clots to form, increasing your risk of a stroke. PRADAXA lowers the chance of blood clots forming in your body.

IMPORTANT SAFETY INFORMATION ABOUT PRADAXA

PRADAXA can cause bleeding which can be serious and sometimes lead to death. Don't take PRADAXA if you currently have abnormal bleeding or if you have ever had an allergic reaction to it. **Your risk of bleeding with PRADAXA may be higher if you:** are 75 years old or older, have kidney problems, have stomach or intestine bleeding that is recent or keeps coming back or you have a stomach ulcer, take other medicines that increase your risk of bleeding, like aspirin products, non-steroidal anti-inflammatory drugs (NSAIDs) and blood thinners.

Call your doctor or seek immediate medical care if you have any of the following signs or symptoms of bleeding: any unexpected, severe, or uncontrollable bleeding; or bleeding that lasts a long time, unusual or unexpected bruising,

coughing up or vomiting blood; or vomit that looks like coffee grounds, pink or brown urine; red or black stools (looks like tar), unexpected pain, swelling, or joint pain, headaches and feeling dizzy or weak.

It is important to tell your doctor about all medicines, vitamins and supplements you take. Some of your other medicines may affect the way PRADAXA works.

Take PRADAXA exactly as prescribed by your doctor. Don't stop taking PRADAXA without talking to your doctor as your risk of stroke may increase.

Tell your doctor if you are planning to have **any** surgery, or medical or dental procedure, because you may have to stop taking PRADAXA for a short time. PRADAXA can cause indigestion, stomach upset or burning, and stomach pain.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

Please see more detailed Medication Guide on next page.

Reduce your risk of a stroke caused by a clot that starts in the heart.

Pradaxa[®]
dabigatran etexilate
CAPSULES

Read this Medication Guide before you start taking PRADAXA and each time you get a refill. There may be new information. This Medication Guide does not take the place of talking with your doctor about your medical condition or your treatment.

What is the most important information I should know about PRADAXA?

- PRADAXA can cause bleeding which can be serious, and sometimes lead to death. This is because PRADAXA is a blood thinner medicine that lowers the chance of blood clots forming in your body.
- **You may have a higher risk of bleeding if you take PRADAXA and:**
 - Are over 75 years old
 - Have kidney problems
 - Have stomach or intestine bleeding that is recent or keeps coming back, or you have a stomach ulcer
 - Take other medicines that increase your risk of bleeding, including:
 - aspirin or aspirin containing products
 - long-term (chronic) use of non-steroidal anti-inflammatory drugs (NSAIDs)
 - warfarin sodium (Coumadin®, Jantoven®)
 - a medicine that contains heparin
 - clopidogrel (Plavix®)
 - prasugrel (Effient®)

Tell your doctor if you take any of these medicines. Ask your doctor or pharmacist if you are not sure if your medicine is one listed above.

- PRADAXA can increase your risk of bleeding because it lessens the ability of your blood to clot. While you take PRADAXA:
 - You may bruise more easily
 - It may take longer for any bleeding to stop

Call your doctor or get medical help right away if you have any of these signs or symptoms of bleeding:

- Unexpected bleeding or bleeding that lasts a long time, such as:
 - unusual bleeding from the gums
 - nose bleeds that happen often
 - menstrual bleeding or vaginal bleeding that is heavier than normal
- Bleeding that is severe or you cannot control
- Pink or brown urine
- Red or black stools (looks like tar)
- Bruises that happen without a known cause or get larger
- Cough up blood or blood clots
- Vomit blood or your vomit looks like "coffee grounds"
- Unexpected pain, swelling, or joint pain
- Headaches, feeling dizzy or weak

Take PRADAXA exactly as prescribed. Do not stop taking PRADAXA without first talking to the doctor who prescribes it for you. Stopping PRADAXA may increase your risk of a stroke.

PRADAXA may need to be stopped, if possible, for one or more days before any surgery, or medical or dental procedure. If you need to stop taking PRADAXA for **any reason**, talk to the doctor who prescribed PRADAXA for you to find out when you should stop taking it. Your doctor will tell you when to start taking PRADAXA again after your surgery or procedure.

See "What are the possible side effects of PRADAXA?" for more information about side effects.

What is PRADAXA?

PRADAXA is a prescription medicine used to reduce the risk of stroke and blood clots in people who have a medical condition called atrial fibrillation. With atrial fibrillation, part of the heart does not beat the way it should. This can lead to blood clots forming and increase your risk of a stroke. PRADAXA is a blood thinner medicine that lowers the chance of blood clots forming in your body.

It is not known if PRADAXA is safe and works in children.

Who should not take PRADAXA?

Do not take PRADAXA if you:

- Currently have certain types of abnormal bleeding. Talk to your doctor, before taking PRADAXA if you currently have unusual bleeding.
- Have had a serious allergic reaction to PRADAXA. Ask your doctor if you are not sure.

What should I tell my doctor before taking PRADAXA?

Before you take PRADAXA, tell your doctor if you:

- Have kidney problems
- Have ever had bleeding problems
- Have ever had stomach ulcers
- Have any other medical condition
- Are pregnant or plan to become pregnant. It is not known if PRADAXA will harm your unborn baby.
- Are breastfeeding or plan to breastfeed. It is not known if PRADAXA passes into your breast milk.

Tell all of your doctors and dentists that you are taking PRADAXA. They should talk to the doctor who prescribed PRADAXA for you, before you have **any** surgery, or medical or dental procedure.

Tell your doctor about all the medicines you take, including prescription and non-prescription medicines, vitamins, and herbal supplements. Some of your other medicines may affect the way PRADAXA works. Certain medicines may increase your risk of bleeding. See **"What is the most important information I should know about PRADAXA?"**

Especially tell your doctor if you take:

- rifampin (Rifater, Rifamate, Rimactane, Rifadin)

Know the medicines you take. Keep a list of them and show it to your doctor and pharmacist when you get a new medicine.

How should I take PRADAXA?

- **Take PRADAXA exactly as prescribed by your doctor.**
- Do not take PRADAXA more often than your doctor tells you to.
- You can take PRADAXA with or without food.
- Swallow PRADAXA capsules whole. Do not break, chew, or empty the pellets from the capsule.
- If you miss a dose of PRADAXA, take it as soon as you remember. If your next dose is less than 6 hours away, skip the missed dose. Do not take two doses of PRADAXA at the same time.
- Your doctor will decide how long you should take PRADAXA. **Do not stop taking PRADAXA without first talking with your doctor. Stopping PRADAXA may increase your risk of stroke.**
- Do not run out of PRADAXA. Refill your prescription before you run out. If you plan to have surgery, or a medical or a dental procedure, tell your doctor and dentist that you are taking PRADAXA. You may have to stop taking PRADAXA for a short time. See **"What is the most important information I should know about PRADAXA?"**
- If you take too much PRADAXA, go to the nearest hospital emergency room or call your doctor or the Poison Control Center right away.

What are the possible side effects of PRADAXA?

PRADAXA can cause serious side effects.

- See "What is the most important information I should know about PRADAXA?"
- Allergic Reactions. In some people, PRADAXA can cause symptoms of an allergic reaction, including hives, rash, and itching. Tell your doctor or get medical help right away if you get any of the following symptoms of a serious allergic reaction with PRADAXA:
 - chest pain or chest tightness
 - swelling of your face or tongue
 - trouble breathing or wheezing
 - feeling dizzy or faint

Common side effects of PRADAXA include:

- indigestion, upset stomach, or burning
- stomach pain

Tell your doctor if you have any side effect that bothers you or that does not go away.

These are not all of the possible side effects of PRADAXA. For more information, ask your doctor or pharmacist.

Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

How should I store PRADAXA?

- Store PRADAXA at room temperature between 59°F to 86°F (15°C to 30°C). After opening the bottle, use PRADAXA within 30 days. Safely throw away any unused PRADAXA after 30 days.
- Store PRADAXA in the original package to keep it dry. Keep the bottle tightly closed.

Keep PRADAXA and all medicines out of the reach of children.

General information about PRADAXA

Medicines are sometimes prescribed for purposes other than those listed in a Medication Guide. Do not use PRADAXA for a condition for which it was not prescribed. Do not give your PRADAXA to other people, even if they have the same symptoms. It may harm them.

This Medication Guide summarizes the most important information about PRADAXA. If you would like more information, talk with your doctor. You can ask your pharmacist or doctor for information about PRADAXA that is written for health professionals.

For more information, go to www.PRADAXA.com or call 1-800-542-6257 or (TTY) 1-800-459-9906.

What are the ingredients in PRADAXA?

Active ingredient: dabigatran etexilate mesylate

Inactive ingredients: acacia, dimethicone, hypromellose, hydroxypropyl cellulose, talc, and tartaric acid. The capsule shell is composed of carrageenan, FD&C Blue No. 2, FD&C Yellow No. 6, hypromellose, potassium chloride, titanium dioxide, and black edible ink.

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Ingelheim

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✓Yes



✓Yes



✓Yes



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes

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2012 Buick Regal GS
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ENGINE

2.0-liter turbocharged
14; 270 hp, 295 lb-ft

TRANSMISSION

Six-speed manual or
automatic

0-TO-60

6.7 seconds, estimated

BRAKES

14-inch front discs
with four-piston
Brembo calipers



BUICK'S BMW

Buick reserved its Gran Sport stamp for its high-performance cars, but the GS badge hasn't meant much in decades. That's about to change with the upcoming Regal GS. This new version of the Regal packs an impressive suite of hardware—a punchy 270-hp engine, stout brakes, adjustable shock absorbers, firm, well-supported seats and sharp styling enhancements. Plus, it's available with the hallmark of any driver's car: a manual transmission (an automatic is available). On GM's Milford,

Mich., handling track, the GS felt more European than domestic, with crisp turn-in response, precise steering and fantastically strong stoppers. High-powered front-wheel-drive cars are usually a handful, but the GS adroitly channels the power. While not a straight-line rocket, there's enough sauce to entertain all but the most jaded horsepower fiends. Next to Cadillac's offerings, the GS is the best-driving sedan in GM's stable and a good value to boot.

— LARRY WEBSTER

New Cars TEST DRIVES



"M" IS FOR MORE

W

With cleaner lines and a cushier interior, Mercedes-Benz's third-generation M-Class is a ground-up redo that's nominally longer, wider and lower than its predecessor, with a lengthier list of standard equipment at the same \$48,990 starting price. The ML comes with a choice of two direct-injected powerplants: a 3.5-liter gas engine (302 hp, 273 lb-ft of torque) or a 3.0-liter diesel (240 hp, 455 lb-ft of torque). On the open road, the M-Class was more of a comfy long-distance cruiser than a viscerally rewarding performance machine. Higher-powered variants due in about a year should satisfy lead-foots when they arrive. Until then, the ML delivers a solid people mover—yeah, it's got all-wheel drive, but it's no off-roader—that slots squarely between the smaller GLK and the plus-size GL.

— BASEM WASEF

2012
Mercedes-Benz M-Class

2012
Porsche Cayman R

BENCHMARKER

Enthusiasts believe that the more stripped-down and pure a Porsche is, the tighter the bond between man and machine. Enter the Cayman R, an even more focused version of the Cayman. Engineers carved over 100 pounds from the sportster by using lighter components. The interior door handles were removed and replaced by fabric pull loops. Even the air conditioning was sacrificed. Yet despite the pared-down features, the \$66,300 R costs four grand more than the Cayman S. Buyers do at least get another 10 hp from the 3.4-liter flat six (330 total). But really, what the Cayman R delivers is an unmatched driving experience. The steering provides the most direct and natural feel of any car we've driven. The suspension tune is equally brilliant on any surface too. But the incredibly supportive and comfortable seats do tend to hold in the heat when there's no air conditioning. Our advice? Wear shorts. — BEN STEWART

AUTO INTEL

i3 BMW's compact electric car, dubbed the i3, will be available in 2013. Designed to be more affordable than the upcoming six-figure i8 sport coupe, the roughly \$35,000 i3 uses a similar pricey carbon-fiber body to reduce weight and increase range.

45 The estimated miles per gallon of the Chevrolet Cruze Diesel planned for release in 2013. This is GM's first diesel-powered car in the U.S. since its infamous diesel debacle of the 1980s.

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ADJUSTMENT
FROM REAR

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If you think one 3-point hitch is as good as the next, try changing implements. The premium 3-point hitch on Bobcat® compact tractors offers the best features for truly simple removal and hookup. Telescoping lower links extend back and forth, eliminating the need to precisely position your tractor. On tractor models 335 and above, the handy 3-point position lever allows you to raise and lower the links from the back of the tractor. Leave the last job behind and get on with the next. There's only one manufacturer with standards as high as yours. Find out more at www.bobcat.com/standard10



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One Tough Animal

New Cars TEST DRIVES

ROCKHOUND

The Jeep Wrangler has always been an off-road mule—more at home on the rocks than on the road. And let's face it, the Wrangler was bog-slow. No more. The \$22,045 new Wrangler uses the same 3.6-liter V6 that debuted in the new Grand Cherokee last year, and it comes paired with

a five-speed automatic or a six-speed manual. The motor cranks out 285 hp and a solid 260 lb-ft of torque. That's an improvement of 83 hp and 23 lb-ft of torque. Those are big numbers. In a drag race, the old Wrangler falls behind the new one as if it were saddled with a heavy trailer. The new Jeep boasts a 25 percent improvement in 0-to-60 acceleration and 10 percent in fuel economy. But don't think the latest Wrangler has gone soft. We tackled California's famed Rubicon Trail in the new Wrangler. Crawling up wet rocks, the Jeep would slide around, hunt for traction and sometimes slam hard onto its skidplates as a tire would fall off a rock—only to claw back up onto the next one. We snaked the Jeep through incredibly tight boulder fields, powered out of mudholes and waded through doorsill-deep pools of water. After 9 hours of trail bashing, a few scraped bumpers was the extent of the damage. It's good to know this Jeep is still . . . a Jeep. — BEN STEWART



2012

Jeep Wrangler

2012

Jeep Grand Cherokee SRT8

AUTO INTEL

54.5

The Corporate Average Fuel Economy (CAFE) standard for U.S. passenger cars by 2025. Automakers may have a rough road ahead.

20

The percentage difference between the CAFE number as calculated by NHTSA and the lower EPA-estimated vehicle fuel economy, which is a better gauge of real-world economy. In addition, there are several CAFE loopholes, including credits for EVs and the use of environmentally friendly a/c refrigerant, that will reduce the real-world number even further.

BENT REALITY

As we rocket over a deserted stretch of the Angeles Crest Highway north of L.A., our senses tell us we're driving a high-powered V8 sport sedan—not a 5150-pound SUV with a 2.5-ton tow rating and 68.7 cubic feet of cargo volume. The full-throttle response out of a corner pins passengers against the seats, the adjustable suspension minimizes body roll but doesn't ruin the ride, and the steering communicates road surface nuances

while filtering out extraneous static. The high-performance and high-luxe 2012 Jeep Grand Cherokee SRT8 is among Chrysler's Street and Racing Technology group's hottest creations and will arrive this fall for \$55,295. The 6.4-liter Hemi engine cranks out 470 hp and 465 lb-ft of naturally aspirated torque that makes 60 mph arrive in the mid-4-second range. The pull doesn't stop until 160 mph. Time to go hunting Porsches.

— REX ROY



Do you have constant **RINGING** in your ear?



Finally, new discovery for quiet relief!

A breakthrough by a rock drummer finds combination of scientifically advanced ingredients combined with homeopathy to relieve the ringing, which could save thousands from risky and expensive treatments.

Every night for almost 18 years, if I couldn't find a fan, turn on a tv or find loud static from a vacant radio station, then sleeping was impossible. The high-pitched ringing, buzzing and humming kept me up at night. Sluggishness, tiredness and lost energy would be my nemesis the next day. I couldn't take it - it was a major problem. I couldn't sleep. I couldn't concentrate. I heard it constantly, I couldn't hide from it...It drove me nuts! Headaches, depressive mood swings, testiness, constant state of anxiety. Due to the tenacity of Tinnitus (the ringing in the ears from exposure to loud noises, or in my case, pounding on drums and loud distorted guitar amps behind my head for years), I was determined to find real, pure, silent relief and I did with Quietus™...

Tinnitus - Who's at RISK?

- Carpentry & Construction
- Mining, Drilling & Farming
- Firearms Enthusiasts
- Residential Landscapers
- iPod Users
- Machine Operators
- Night Club Workers
- Musicians

The symptoms of Tinnitus are real. I had what 1 out of 6 Americans get: the symptoms associated with Tinnitus (*ti-nahy-tuh s*) from loud noises that worsen as you age, and in many cases lead to hearing loss.



Silence is now music to my ears.

I tried everything from hearing aid sound generators to ginkgo biloba, zinc and magnesium mineral doses to bio feedback. Some of these things helped reduce the ringing, but nothing worked short of expensive, risky surgery. Not until I discovered the active all-natural ingredients of my new homeopathic product Quietus, did my prolonged ear ringing finally silence.

***"RELIEVE the ringing, CALM the hissing.
Let peace & mental clarity begin."***

Just one small tab twice a day unleashes an exclusive proprietary blend of ingredients, including the same select herbs FDA compliant as Homeopathic Pharmacopoeia of the US. Quietus uses scientifically advanced homeopathic technology that supports the body's own healing mechanism that cancels out symptoms such as roaring, buzzing & whizzing, and supports healthy functioning in the inner ear...**safely & naturally.**

The Choice is Clear for Quiet Relief

Quietus	Ginkgo Biloba	Minerals: Zinc/Mag.	Hearing Aids	Bio Feedback	TR Therapy	Surgery
Affordable	✓					
Safe	✓		✓	✓		
No Doctors	✓					
Fast-Acting	✓	✓				✓
Effective	✓				✓	✓
Convenient	✓					
Money-Back Guarantee	✓					

No other treatment that I know of matches the relief that Quietus provides with effectiveness, speed and convenience. With Quietus, the ringing stops and the comfortable silence will peacefully lull you to sleep at bedtime. When the ringing stops, remembering people's names becomes easier. Mental clarity becomes your calling card. Intense focus becomes your edge...

Bernard
BERNARD - CREATOR, DRUMMER.

Popular Mechanics Exclusive Offer

Quietus is not available in stores. To protect it's proprietary homeopathic formula, as well as your risk-free trial, Quietus is available by special request directly from our lab for a limited time for Popular Mechanics readers. I am so confident in the advanced technology of Quietus and I want you to experience the same life-altering relief I did, that you'll receive a special **30-day RISK-FREE trial*** by calling us direct! Ask how to receive a **FREE Supply** with your order.



1-800-305-1639

*Shipping and handling non-refundable. QuietRelief.com

New Cars TEST DRIVES

OUTSMARTING THE OTHER GUYS



Scion packed a lot of innovation into the iQ, mostly to make everything fit into its tiny overall length of 10 feet. That's a bit bigger than a Smart Fortwo but lots smaller than a Fiat 500 or Mini Cooper. To adjust, the iQ engineers had to come up with a more compact differential and a high-mount electronic steering rack, and they stashed the flat 8.5-gallon fuel tank under the seats. There's room inside for three adults and a small child, and there are 11 airbags, including a rear-window one. The full panoply of ABS, traction- and stability-control features, power accessories and premium audio makes it clear this is no toy car, yet it starts at \$15,995. The iQ's suspension tuning gives it a smooth, quiet ride. The 1.3-liter 94-hp four-cylinder engine and CVT (continuously variable transmission) can be noisy when pushed hard, and it's barely quicker than a Smart Fortwo in the sprint to 60 mph (about 12 seconds). The handling won't excite car enthusiasts the way a Mini Cooper does, but the 37-mpg combined city/highway fuel-economy rating is better than most of the cars that heavily advertise 40 mpg and print "highway" in tiny type. — KEVIN WILSON

2012
Scion iQ2012
Toyota Camry

PACK LEADER

The arrival of a new Toyota Camry is an occasion to watch. It's been the best-selling car in the U.S. for 13 of the past 14 years. Because people buy this car more than any other, a new Camry is both a reflection and a prediction of what Americans want to drive. This one rides on an improved version of the same chassis, and the dimensions are nearly identical to the outgoing model. For the first time in Camry history, it hasn't grown. But even though the new Camry (\$21,955) is the same size and packs more technology than its predecessor, it's actually lighter and roomier inside. The gentle ride dampens out the nastiest roads. The SE package responds with more athleticism than any Camry before it. The four-cylinder and V6 engines haven't changed and are backed by six-speed automatics. But the Hybrid (\$27,400) received the most attention. System improvements made it a half-second quicker to 60 mph and pushed fuel economy to 43 mpg city. Hey, who needs a Prius?

— BEN STEWART

AUTO INTEL

53,500

The number of competitors Bryan Heitkotter beat to win the U.S. version of the GT Academy, a video-game contest that uses Gran Turismo 5 to find potential race-car drivers. Heitkotter will join Nissan's racing program as a paid driver. See, Mom, playing video games pays.

1990

The last year a new U.S. car came with a carburetor. Starting next year, Nascar will finally replace carburetors with fuel injection.



A FEW WILL LEAD.

Our officer candidates are rigorously screened, tested and evaluated for the moral, intellectual and physical qualities required to lead Marines in defense of our nation. If you prove



you have what it takes to become a Marine Officer, the path of most resistance will lead to a life of distinction, purpose and honor. Few can be Marines. Even fewer can lead them.

MARINES
THE FEW. THE PROUD.

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New Cars TEST DRIVES

AUTO INTEL

800

The number of electric-car charging stations that Walgreens, the nation's largest drugstore chain, will install at as many stores by year-end. The stations will cost money to use, so try to refrain from going on a shampoo shopping spree while you wait.

90

The number of outdated charging stations Costco, a warehouse retail and grocery chain that started offering electric charging stations as far back as the mid-1990s, is removing. The store said the stations were underused.



HYUNDAI'S HIGH HORSE

T

Take Hyundai's already strong 4.6-liter V8, bore it out to 5.0 liters and add direct injection for its most powerful engine ever, at 429 hp. Then, couple it to an all-new, eight-speed automatic, sharpen the steering and stiffen the suspension and you have the Genesis R-Spec sedan, which impressed us with its luxurious and sporty attributes on roads around Las Vegas. At \$47,350 fully equipped, it runs with big dogs like the BMW 550i but leaves enough in the kitty to put a well-equipped new Accent in the garage, too. To make use of the eight-speed, we'd have preferred that the R-Spec offer paddle shifters such as those in the Genesis Coupe. Hyundai won't confirm, but it's likely that the 5.0-liter V8 will find its way into the Genesis Coupe—not to mention the Equus—in the not-too-distant future.

— KEVIN WILSON

RIO, BRAVO!

The last time we toiled around in Kia's Rio5, in 2009, we gave high marks to the subcompact's quick feel and fun quotient, but noted highway noise, the lack of power locks and windows, and the interior's discount plastics and upholstery. The manual locks and window cranks remain on the LX trim version of the all-new Rio5, which is due stateside in late September in sedan and hatchback variations with a base price of less than \$14,000. (Powered hardware comes with the EX, which we drove, and the SX trim.) But burrowing through 25 tunnels on a coast-to-coast route across rumpled South Korea, we confirmed that the quickness and fun remain—in fact, they've improved. Kia's direct-injection system boosts output from the 1.6-liter engine by 25 percent to 138 hp, which made it tough to stay legal under the watchful eyes of no less than 27 speed cameras. The Idle Stop and Go system, which subtly turns the engine off when the vehicle is stationary, helps boost the sedan's fuel economy to 30/40 mpg (city/highway). The handling is tight, and the six-speed automatic is smooth and alert to downshifts. (A six-speed manual comes with the LX.) Kia engineers have also hushed the roomy cabin, and the fabric seats and leather accents make the EX look sharp and athletic, not bargain-basement. — DAVID DUNBAR

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New Cars ENGINE OF THE MONTH

2012
Toyota Yaris

SAFE PLAY

Not long ago, the subcompact class was peppered with wheezy, dimwitted and downright unpleasant transportation pods. Then came the rebellious Scion. Soon after, Honda brought along the clever Fit—a car that has set the bar high for other small cars, including the newly refreshed Toyota Yaris. Mechanically, the new Yaris is the same old Yaris, packing a 106-hp four-cylinder mated to a five-speed manual or a four-speed automatic. It's a powertrain that's a little dated, a little coarse and, in general, just enough to get by. By stretching the old chassis 2 inches, cargo volume is up from 9.3 cubic feet to 15.6. Toyota did this while reducing the car's overall weight by around 40 pounds. Impressive. The friskier SE version of the Yaris is a bit more fun to throw into a tight corner. The Yaris is a lot of car for its \$14,115 base price, but it needs more power and better fuel economy to truly lead the pack. — BEN STEWART

AUDI 1.8 TFSI

ENGINE
OF THE
MONTH

AUDI'S 1.8-LITER TURBO MOTOR PILES ON THE TECH FOR GREATER EFFICIENCY AND CLEANER EXHAUST.

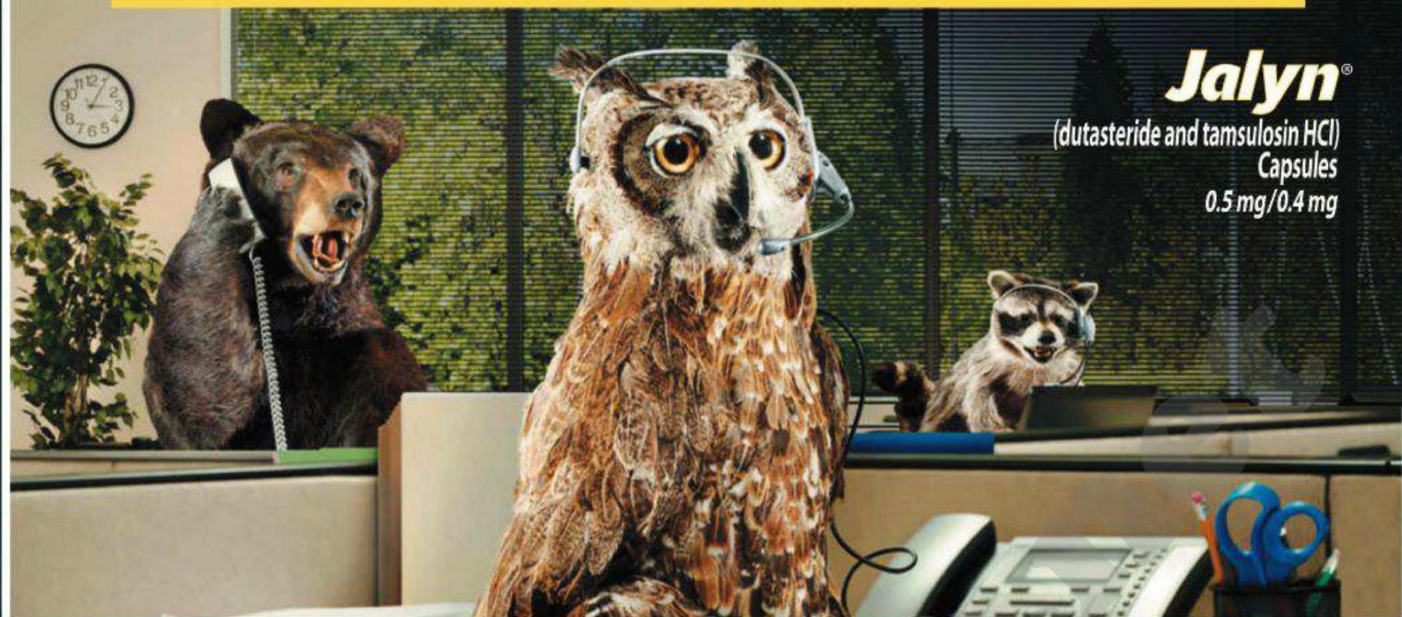
Audi pioneered the combination

of direct injection and turbocharging in 2006. The two technologies are perfect complements; turbos stuff more air into an engine, and directly injecting fuel into the combustion chamber means more controlled ignition and lower fuel consumption. Now Audi has upped its game with several new features. First, in addition to the primary direct-injection system, there's a parallel fuel-injection circuit, which comes into play when the engine isn't under heavy throttle. It delivers fuel just ahead of the intake valves to maximize atomization in the turbulent airflow, improving combustion efficiency and thus fuel economy. In addition, a two-stage

valve-lift mechanism has been added to enhance exhaust removal. Altering the valve lift and the cam timing ensures optimum airflow over a wide range of engine speeds and loads.

An electrically powered dual-circuit coolant system enables optimization of engine oil temperatures to reduce friction while keeping the vital top-end components cool. Bottom line: The engine delivers a stout 236 lb-ft of torque at 1400 rpm yet burns 21 percent less fuel. Presently, the 1.8-liter engine is slated only for Europe, but with tightening fuel-economy standards, the hardware and concepts will surely spread to the 2.0-liter unit currently sold here. — BEN WOJDYLA

IS NATURE CALLING DAY AND NIGHT?



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0.5 mg/0.4 mg

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For guys with symptomatic benign prostatic hyperplasia (BPH), nature calls a little too often. JALYN can help reduce urinary symptoms of BPH in men with an enlarged prostate. JALYN is not approved for the prevention of prostate cancer.

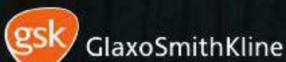
It's time to ask your doctor if JALYN is right for you.

www.JALYN.com

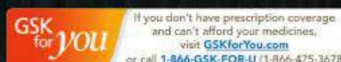
Important Safety Information About JALYN

- JALYN is for adult men only. Women should not take or touch JALYN due to risk of a specific birth defect. If a woman comes in contact with leaking JALYN Capsules, she should wash the contact area immediately with soap and water.
- Do not take JALYN if you are allergic to dutasteride, finasteride, tamsulosin, or any of the ingredients in JALYN.
- JALYN may cause rare and serious allergic reactions, including: swelling of your face, tongue, or throat, and serious skin reactions, such as skin peeling. Get medical help right away if you have these serious allergic reactions.
- JALYN may cause a sudden drop in blood pressure upon standing, especially when starting treatment, which may cause you to faint, or feel dizzy or lightheaded. Avoid driving or operating hazardous equipment when starting or restarting JALYN.
- Tell your doctor about all the medicines you take, including prescription and non-prescription medicines, vitamins, and herbal supplements. JALYN and other medicines may affect each other, causing side effects.
- Some types of medicines should not be taken with JALYN, including: ketoconazole, an antifungal medication, which if taken with JALYN can increase levels of tamsulosin, a component of JALYN; and alpha-blockers, like tamsulosin, which if taken with JALYN may cause fainting, dizziness, or feeling lightheaded.
- Some types of medicines should be used with caution when taken with JALYN, including: erythromycin, paroxetine, or terbinafine, which when taken with JALYN can increase levels of tamsulosin, a component of JALYN; cimetidine; certain types of medicines that are commonly used to treat erectile dysfunction, which when taken with JALYN may cause fainting, dizziness, or feeling lightheaded; and warfarin.
- Only your healthcare provider can tell if your symptoms are due to BPH or a more serious condition like prostate cancer. See your doctor for regular exams.
- JALYN may cause serious side effects including a higher chance of a more serious form of prostate cancer.
- Your healthcare provider may check you for other prostate problems, including prostate cancer, before you start and while you take JALYN. A blood test called PSA (prostate-specific antigen) is sometimes used to see if you might have prostate cancer. JALYN will reduce the amount of PSA measured in your blood. Your healthcare provider is aware of this effect and can still use PSA to see if you might have prostate cancer. Increases in your PSA levels while on treatment with JALYN (even if the PSA levels are in the normal range) should be evaluated by your healthcare provider.
- Rarely, JALYN can cause a painful erection. If this happens get medical help right away.
- Do not donate blood until 6 months after stopping JALYN.
- Before you take JALYN, tell your doctor if you: have a history of low blood pressure, plan to have cataract surgery, are allergic to sulfa medications, take medicines to treat high blood pressure, have liver problems, or have any other medical conditions.
- The most common side effects include: ejaculation problems, trouble getting or keeping an erection (impotence), a decrease in sex drive (libido), decreased amount of semen released during sex, dizziness, enlarged or painful breasts (if you notice breast lumps or nipple discharge, you should talk to your healthcare provider), and runny nose.

Please see the next page for Patient Information about JALYN.



You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.



PATIENT INFORMATION

JALYN™ [JAY-LIN] (dutasteride and tamsulosin hydrochloride) Capsules

JALYN is for use by men only.

Read this patient information before you start taking JALYN and each time you get a refill. There may be new information. This information does not take the place of talking with your healthcare provider about your medical condition or your treatment.

What is JALYN?

JALYN is a prescription medicine that contains 2 medicines: dutasteride and tamsulosin. JALYN is used to treat the symptoms of benign prostatic hyperplasia (BPH) in men with an enlarged prostate.

Who should not take JALYN?

Do Not Take JALYN if you are:

- pregnant or could become pregnant. JALYN may harm your unborn baby. Pregnant women should not touch JALYN Capsules. If a woman who is pregnant with a male baby gets enough JALYN in her body by swallowing or touching JALYN, the male baby may be born with sex organs that are not normal. If a pregnant woman or woman of childbearing potential comes in contact with leaking JALYN Capsules, the contact area should be washed immediately with soap and water.
- a child or teenager.
- allergic to dutasteride, tamsulosin, or any of the ingredients in JALYN. See the end of this page for a complete list of ingredients in JALYN.
- taking another medicine that contains an alpha-blocker.
- allergic to other 5 alpha-reductase inhibitors, for example, PROSCAR® (finasteride) Tablets.

What should I tell my healthcare provider before taking JALYN?

Before you take JALYN, tell your healthcare provider if you:

- have a history of low blood pressure
- take medicines to treat high blood pressure
- plan to have cataract surgery
- have liver problems
- are allergic to sulfa medications
- have any other medical conditions

Tell your healthcare provider about all the medicines you take, including prescription and non-prescription medicines, vitamins, and herbal supplements. JALYN and other medicines may affect each other, causing side effects. JALYN may affect the way other medicines work, and other medicines may affect how JALYN works.

Know the medicines you take. Keep a list of them to show your healthcare provider and pharmacist when you get a new medicine.

How should I take JALYN?

- Take JALYN exactly as your healthcare provider tells you to take it.
- Swallow JALYN Capsules whole. Do not crush, chew, or open JALYN Capsules because the contents of the capsule may irritate your lips, mouth, or throat.
- Take your JALYN 1 time each day, about 30 minutes after the same meal every day. For example, you may take JALYN 30 minutes after dinner every day.
- If you miss a dose, you can take it later that same day, 30 minutes after a meal. Do not take 2 JALYN Capsules in the same day. If you stop or forget to take JALYN for several days, talk with your healthcare provider before starting again.
- If you take too much JALYN, call your healthcare provider or go to the nearest hospital emergency room right away.

What should I avoid while taking JALYN?

- Avoid driving, operating machinery, or other dangerous activities when starting treatment with JALYN until you know how JALYN affects you. JALYN can cause a sudden drop in your blood pressure, especially at the start of treatment. A sudden drop in blood pressure may cause you to faint, feel dizzy or lightheaded.
- You should not donate blood while taking JALYN or for 6 months after you have stopped JALYN. This is important to prevent pregnant women from receiving JALYN through blood transfusions.

What are the possible side effects of JALYN?

JALYN may cause serious side effects, including:

- **Decreased blood pressure.** JALYN may cause a sudden drop in your blood pressure upon standing from a sitting or lying position, especially at the start of treatment. Symptoms of low blood pressure may include:

- fainting
- dizziness
- feeling lightheaded

Rare and serious allergic reactions, including:

- swelling of your face, tongue, or throat
 - serious skin reactions, such as skin peeling
- Get medical help right away if you have these serious allergic reactions.

Higher chance of a more serious form of prostate cancer.

- **Eye problems during cataract surgery.** During cataract surgery, a condition called intraoperative floppy iris syndrome (IFIS) can happen if you take or have taken JALYN in the past. If you need to have cataract surgery, tell your surgeon if you take or have taken JALYN.

- **A painful erection that will not go away.** Rarely, JALYN can cause a painful erection (priapism), which cannot be relieved by having sex. If this happens,

get medical help right away. If priapism is not treated, there could be lasting damage to your penis, including not being able to have an erection.

The most common side effects of JALYN include:

- ejaculation problems
- trouble getting or keeping an erection (impotence)
- a decrease in sex drive (libido)
- dizziness
- enlarged or painful breasts. If you notice breast lumps or nipple discharge, you should talk to your healthcare provider.
- runny nose

Dutasteride, an ingredient of JALYN, has been shown to reduce sperm count, semen volume, and sperm movement. However, the effect of JALYN on male fertility is not known.

Prostate-Specific Antigen (PSA) Test: Your healthcare provider may check you for other prostate problems, including prostate cancer, before you start and while you take JALYN. A blood test called PSA (prostate-specific antigen) is sometimes used to see if you might have prostate cancer. JALYN will reduce the amount of PSA measured in your blood. Your healthcare provider is aware of this effect and can still use PSA to see if you might have prostate cancer. Increases in your PSA levels while on treatment with JALYN (even if the PSA levels are in the normal range) should be evaluated by your healthcare provider.

Tell your healthcare provider if you have any side effect that bothers you or that does not go away.

These are not all the possible side effects with JALYN. For more information, ask your healthcare provider or pharmacist.

Call your doctor for medical advice about side effects. You may report side effects to the FDA at 1-800-FDA-1088.

How should I store JALYN?

- Store JALYN Capsules at room temperature (59° to 86°F or 15° to 30°C).
- JALYN Capsules may become deformed and/or discolored if kept at high temperatures.
- Do not use or touch JALYN if your capsules are deformed, discolored, or leaking.
- Safely throw away medicine that is no longer needed.

Keep JALYN and all medicines out of the reach of children.

Medicines are sometimes prescribed for purposes other than those listed in a patient page. Do not use JALYN for a condition for which it was not prescribed. Do not give JALYN to other people, even if they have the same symptoms that you have. It may harm them.

This patient information page summarizes the most important information about JALYN. If you would like more information, talk with your healthcare provider. You can ask your pharmacist or healthcare provider for information about JALYN that is written for health professionals.

For more information, go to www.JALYN.com or call 1-888-825-5249.

What are the ingredients in JALYN?

Active ingredients: dutasteride and tamsulosin hydrochloride

Inactive ingredients: black ink, butylated hydroxytoluene, carrageenan, FD&C yellow 6, ferric oxide (yellow), gelatin (from certified BSE-free bovine sources), glycerin, hypromellose, iron oxide red, methacrylic acid copolymer dispersion, microcrystalline cellulose, mono-di-glycerides of caprylic/capric acid, potassium chloride, talc, titanium dioxide, and triethyl citrate.

How does JALYN work?

JALYN contains 2 medications, dutasteride and tamsulosin. These 2 medications work in different ways to improve symptoms of BPH. Dutasteride shrinks the enlarged prostate and tamsulosin relaxes muscles in the prostate and neck of the bladder. These 2 medications, when used together, can improve symptoms of BPH better than either medication when used alone.

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June 2011

JLN:2PIL

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Visit www.dowgreatstuff.com/workwipes for more information.

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Brand Anew

> BY JAY LENO
> PHOTOGRAPHS BY JOHN LAMM



In place of authentic Halibrand mag wheels, replicas such as these are popular with restorers.

CLASSIC AMERICAN AUTO BRANDS ARE BEING REBORN, AND JAY APPROVES.

THE KING IS BACK.

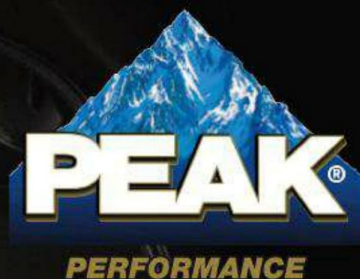
If you grew up around racetracks and car enthusiasts in the '50s and '60s, you're probably familiar with King and Sun distributor test machines. Unlike today's vehicles, those old cars didn't come with computers to aid the ignition process. They used mechanical distributors. A distributor test machine pinpoints the most accurate ignition timing for a vehicle, maximizing horsepower and efficiency.

Sun is now owned by a Dutch company and doesn't even make distributor diagnostic machines anymore. The original King Company was founded in 1911 in Cleveland and went out of business a few years ago. Without these machines, even the best mechanic is guessing at timing accuracy. And it's not like cars with distributors have suddenly disappeared altogether.

A California man named Deke Williams realized this. So he bought the rights to the King Company name, saved a 100-year-old American brand and

designed a modern version of the original King tester. Preserving old American companies such as the King Company is critical. When these brands fade away, a key part of our industrial heritage is gone forever. Now the King Company is named King Electronics and is located in Southern California.

The company's all-new distributor tester is called the D16. It combines mechanical and modern electronic features, and it can spin a distributor or a magneto as high as 11,000 rpm. With



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JAY LENO'S GARAGE/// BRAND ANEW

it, you can test any ignition system, from the distributor to the spark plugs, whether it's a mechanical distributor with points, electronic or magnetic pickup or optical sensors—almost any configuration. One costs \$2995, but you'd pay nearly that much for a restored Sun Model 504 machine on eBay. The tester is ideal for any garage or restoration shop.

In addition to King, a few other esteemed companies are being revitalized. S-K Tools, founded in 1921 by Mason H. Sherman and Roger Klove, originally built its products in Chicago and Ohio. An iconic American brand for decades, S-K invented and patented the round-head socket wrench and offered a lifetime warranty on all of its products. Thanks to superb quality, the tools developed a faithful following.

Through the years, the company survived many changes in ownership, but it eventually declared bankruptcy in 2010. Ideal Industries purchased the company, and today, using many original dies, SK Hand Tool is once again manufacturing quality ratchets, sockets and specialty tools in Sycamore, Ill., and Colorado Springs, Colo. The company even offers the same lifetime warranty.

For baby boomers, it wasn't unusual to hear people talk about mag wheels when we were growing up. What many people didn't realize was that mag stood for magnesium. In 1946, Ted Halibrand, an amateur race car driver, produced a set of magnesium alloy wheels intended for racing. He'd come up with the idea after using the metal on planes he helped build for World War II. His wheels were lighter and stronger than wire wheels, so in 1947 he established Halibrand Engineering in Culver City, Calif. The wheels quickly caught on with other racers. Beginning in 1951, every car that won the Indianapolis 500 for the next 16 years had Halibrands. Even Carroll Shelby's Cobras sported Halibrand wheels.

Although magnesium is light and



Years ago, King was a popular brand of distributor test machines, which tune old ignition systems. Rights to the struggling company's name were bought in 2009, and now it's making brand-new machines.

strong, when the material is machined, it leaves highly combustible dust and shavings. Ensuring the process is done safely can be expensive. This, combined with competition from cheap overseas wheels and an industry shift to aluminum alloy wheels in the mid- to late '60s, helped diminish demand.

Halibrand sold the company in 1979, and in 2003 it became Halibrand Performance and relocated to Wichita, Kan. The company is currently being reorganized, but it will be back—to the great joy of restorers. Replicas of those original mag wheels are popular.

Another old product that's still popular today is the Stromberg carburetor. Many American cars from the 1920s through the 1950s were equipped with these well-machined carburetors. As hot rodders began using aftermarket intake manifolds such as the Offenhauser unit, with bosses for three carbs, the Stromberg became the go-to fuel mixer. They were cheap, plentiful and known for stone-like reliability. Restorers and hot rodders today covet them.

But with the rebuildable cores from the original carburetors costing

\$200 to \$250, it made sense for the Edelbrock Corp. to begin manufacturing Stromberg Model 94 carburetors again. Why mess with a 60-year-old component when you can have a brand-new carburetor exactly like the original for \$375 to \$400?

When engineers for major carmakers come to my garage and I show them a steam engine or a magneto ignition, they have no idea how these old components work. The technology has just passed them by. I think if you're going to move forward with new technology, it's important to know and understand all that came before. That goes for companies, too.

Saving old companies should be a top priority. They are part of our nation's automotive DNA and still relevant today—just on a smaller scale. But remember, unless you're saving the factories and the workers, you're just saving a name. Preserving these manufacturing skills and jobs is key.

It's the same with people. I support McPherson College in McPherson, Kan., because it has a bachelor's degree program that trains young people in auto restoration. Without these folks, future generations won't have the pleasure of experiencing a classic car in all its original glory. What a horrible thought.

Come to think of it, we'd better get McPherson one of those King machines.

PM



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THE VISIONARY

James Cameron with one of the 3D camera rigs he created to film Avatar. The director plans to take a version of the rig on a dive to Challenger Deep—36,000 feet below the surface of the ocean—in a piloted submersible he also helped to engineer.

PHOTOGRAPH BY ART STREIBER

WHEN MOST PEOPLE THINK OF JAMES CAMERON, they first think of his movies: *Aliens*, *Titanic*, *Avatar*, *The Terminator*. Then they might reflect on how his films have pushed major technological advances in the entertainment industry, from the state-of-the-art visual effects that created the water tentacle in *The Abyss* to the high-tech SimulCam system used to film *Avatar*. But for Cameron, Hollywood is just the beginning. His innovations are also expanding human knowledge by exploring new frontiers. "Exploring is, in many ways, my first love," the director says. He has led an expedition to probe the wreck of the German battleship *Bismarck* and helped design 3D cameras for NASA's next Mars rover. "We let Jim shoot pictures with our cameras in Mars orbit," says Michael Ravine, advanced projects manager at Malin Space Science Systems. "When I brought him the 12-foot-long prints, he halted a meeting and came out to sweep the floor so we had a big enough area to unroll them. He was asking questions about collapsed lava tubes while all these movie folks stood around, wondering what was going on." Cameron isn't a scientist—"I think of myself more as a science groupie," he says—but there's no telling how many have been inspired by his work. POPULAR MECHANICS correspondent Anne Thompson spoke with Cameron about his plans to dive to *Challenger Deep*, the real obstacle to colonizing Mars and how humanity should grapple with its greatest challenge.

POPULAR MECHANICS: *Next year you plan to dive to the deepest known point in the ocean in a sub that you've helped design. Why?*

JAMES CAMERON: I believe in exploration. These trenches, which are deeper than 6000 meters, have never been explored. We don't know what's there. Space exploration is really the product of governments. Most individuals can't afford to explore space. For private exploration, we're really bound to the Earth, and the last great frontier is the Hadal trenches. *Footage for both Titanic and the documentary Ghosts of the Abyss came from ROVs.*

How have your undersea vehicles evolved over time?

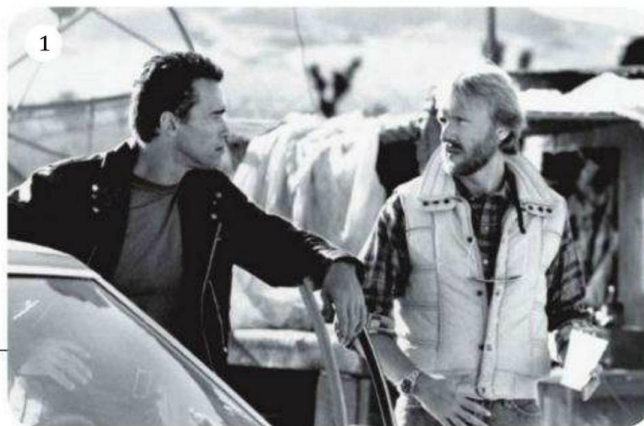
In 1998 we started to engineer these small robotic vehicles that were designed to go inside shipwrecks. We decided to use syntactic foam—the only flotation system that works at extreme depths—structurally on the robotic vehicle, which had never been done before. Now we're building our 23-foot-long piloted submersible, the *Deep Challenger*, entirely out of syntactic foam—except for

the pressure hull, which is the sphere that we all sit inside. *What are the challenges of engineering to withstand deep-sea environments?* At 36,000 feet, you've got 16,000 pounds per square inch of pressure. That translates to tens of millions of pounds distributed over the surface of the sub's pressure sphere. If your pressure port fails, your sub is going to implode. If your penetrator fails, a jet of high-pressure water will enter the sub and cut everything in half. These are the risks that you have to engineer against. But they're also givens from the beginning of every project.

Were there any times on a dive when you were in real danger?

There have been white-knuckle moments—complete power failures, where we've had to use emergency ballast systems to get back. And that gives you an appreciation of the layers of technology that go into these machines to make them safe. I've done 75 submersible dives since 1995, and, yeah, your life is at risk anytime you go into a hostile environment like that. But you trust the engineering.

You were also very involved in developing a 3D camera for the Mars rover Curiosity before NASA's budgetary concerns got in the way. I'm a very minor player in development of the Mastcam, the eyes of the rover that will launch later this year. The camera was originally conceived to be 3D and have two zoom lenses, [but NASA] decided to go with fixed-focal-length lenses in two different focal lengths, meaning we can't do 3D.



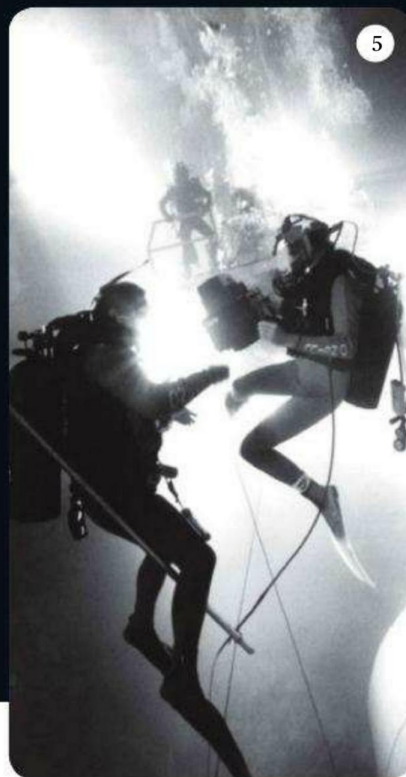
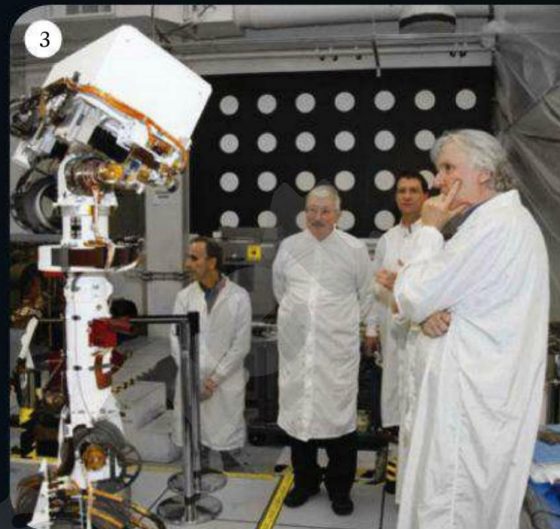
You used 3D in Avatar to create a completely immersive world. What's the value of sending 3D cameras into unexplored places like space and the deep sea? Evolution has made 3D the standard method for viewing the world. There's a heightened sense of being physically present, so people will have a greater appreciation of exploration in general and what is specifically being learned—whether it's on the surface of Mars or at the bottom of the ocean. *Sending cameras is one thing, but do you have any ambitions to go to space yourself?*

Absolutely. I was going to go up on the Russian Soyuz system. Elon Musk's Dragon spacecraft (page 70) will have the ability to send seven people into low Earth orbit—and none too soon. The space shuttle was just sucking up a lot of money and going nowhere fast, literally—going 17,000 miles an hour to stay in orbit. That's like Columbus going to Queen Isabella and saying, "I'm going to explore a new continent. But first I'm going to sit offshore for 30 years and study the problem of people living on small ships."

We've learned a lot about Mars in the past decade.

What will it take to fully explore it? I think it'll be like ocean exploration: a mixture of humans and robotics. We could put the most capable rover on Mars, but there's still as much as a 40-minute lag—so if we tried to tell it to avoid running off a cliff, it would be lying at the bottom in pieces for 40 minutes by the time it got the signal. If you want to get a lot of work done, you've got to put a human there.

What obstacles do we face in actually getting people to Mars? We could use chemical rockets to send people to



Mars. That's not the issue—it's living on the surface. The only way to tackle that problem is to tackle that problem, not talk about it. This country has the potential to be resting on its laurels so long that it loses the capability to do the kinds of things that we pride ourselves on being able to do. No human has been outside low Earth orbit in 40 years. That's crazy!

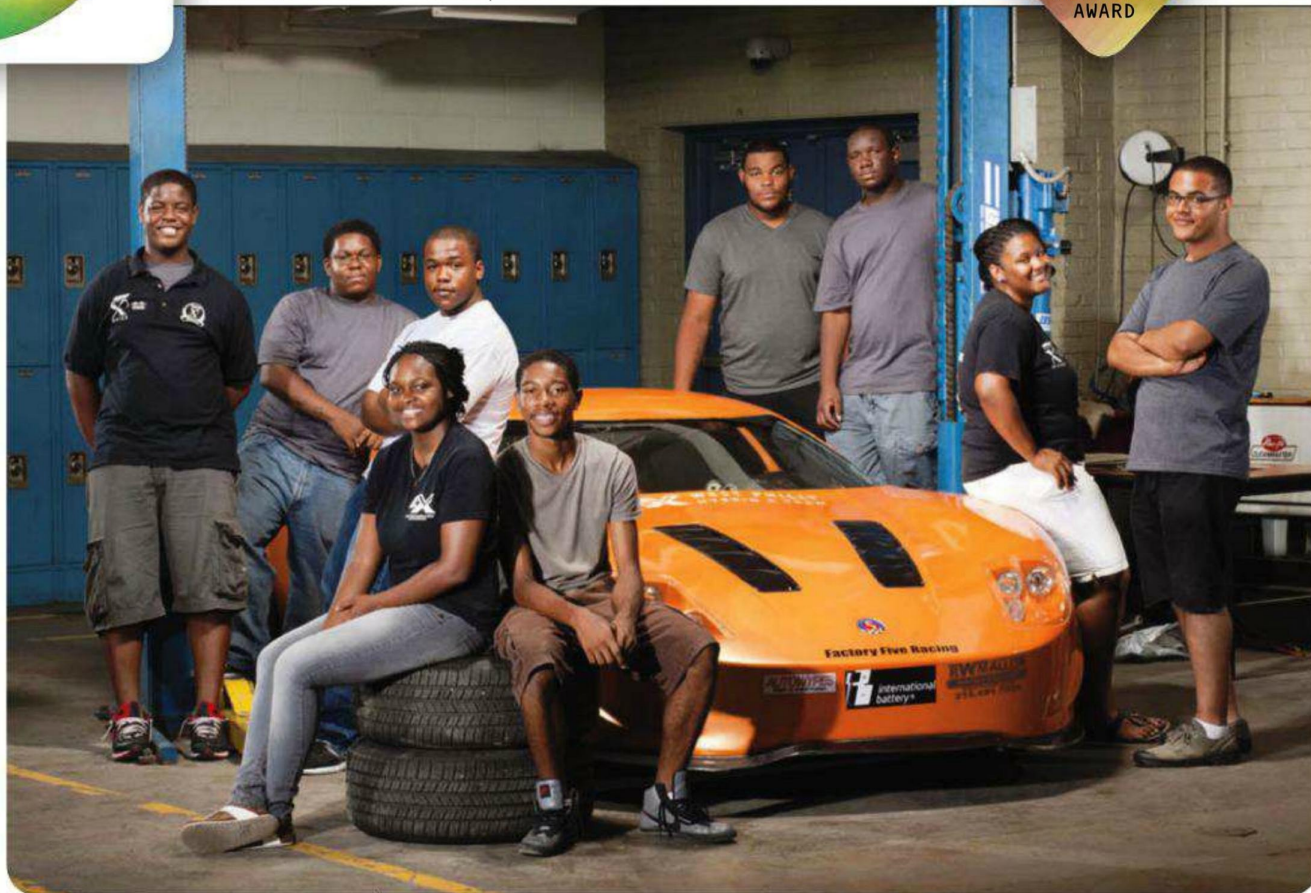
What is the role of science-fiction filmmaking in inspiring people to think boldly? Fantasy and imagination have driven the filmmaking process, which has driven technology. And I know from working in the sciences—especially space science and astronomy—that every one of these scientists was a science-fiction fan when they were a kid. It was an outlet for their imagination and their sense of what was possible.

POPULAR MECHANICS is going to be 110 years old next year. Where will humanity be 110 years from now? We're facing arguably the most challenging century in human history. We have to get our act together and learn to cooperate between nations to solve global-scale problems. This is the turning point where we've exceeded, or will shortly exceed, Earth's ability to support us. And we're going to have to change our thinking. We have to be more organized and self-sacrificing and less contentious, or we're not going to make it.

What do you think we need to do to make these changes happen? We need to start trusting science a whole lot more. We love when science gives us something we want, like the semiconductors in our brand-new iPad. But we don't trust science when it's a message we don't want to hear, like we need to reduce our consumption of resources. There were warnings in science fiction, whose job has always been to imagine the future—whether an exciting future of shiny technology or a dystopian one. And now there are very real warnings from the science community, but we're not taking them seriously. The danger is very real. We are racing toward a cliff with the top down and the radio playing. We've got to wake up.

You're passionate about so many of the topics POPULAR MECHANICS covers. What does winning this award mean to you? The magazine is a mixture of science, engineering and backyard tinkering. I love that, because I like to sit at that particular nexus myself. This award symbolizes that I've managed to pull it off—to do something of value in those areas.

- 1: With Arnold Schwarzenegger on the set of Terminator 2: Judgment Day in 1991.
- 2: Cameron in 1995, before an expedition to the Titanic wreck in a Mir sub.
- 3: Inspecting an engineering model of the 3D Mastcam he helped develop for NASA's next Mars rover, Curiosity.
- 4: With other members of the X-Prize Foundation board of trustees experiencing zero gravity on G-Force One, a modified Boeing 727-200.
- 5: Cameron filming The Abyss in an unused nuclear power plant containment tank filled with 7.5 million gallons of water.

**innovators****WEST PHILLY HYBRID X TEAM**

SIMON HAUGER, FACULTY ADVISER

brilliant idea

A 160-MPG CAR—AND AN AFTER-SCHOOL PROGRAM FOR HANDS-ON EDUCATION

A STUDENT SUPERCAR

OF THE 111 TEAMS that competed for the \$10 million purse in last year's Progressive Insurance Automotive X Prize, only one was from a high school—West Philadelphia, where 85 percent of students are economically disadvantaged. West Philly entered two vehicles—a Factory Five GTM biodiesel hybrid kit car (above) and a converted Ford Focus gasoline plug-in hybrid—and made it to the semifinals with both. “We were going up against teams

that had dozens of engineers, and we had 15 students, a couple of teachers and a dream,” says adviser Simon Hauger, a teacher in the school's Academy of Automotive and Mechanical Engineering. “One of the marvelous things about teenagers is they're not daunted by that.”

After its impressive X Prize performance, West Philly won the Green Grand Prix in Watkins Glen, N.Y., last April, when its GTM achieved the equivalent of

160 mpg over 100 miles.

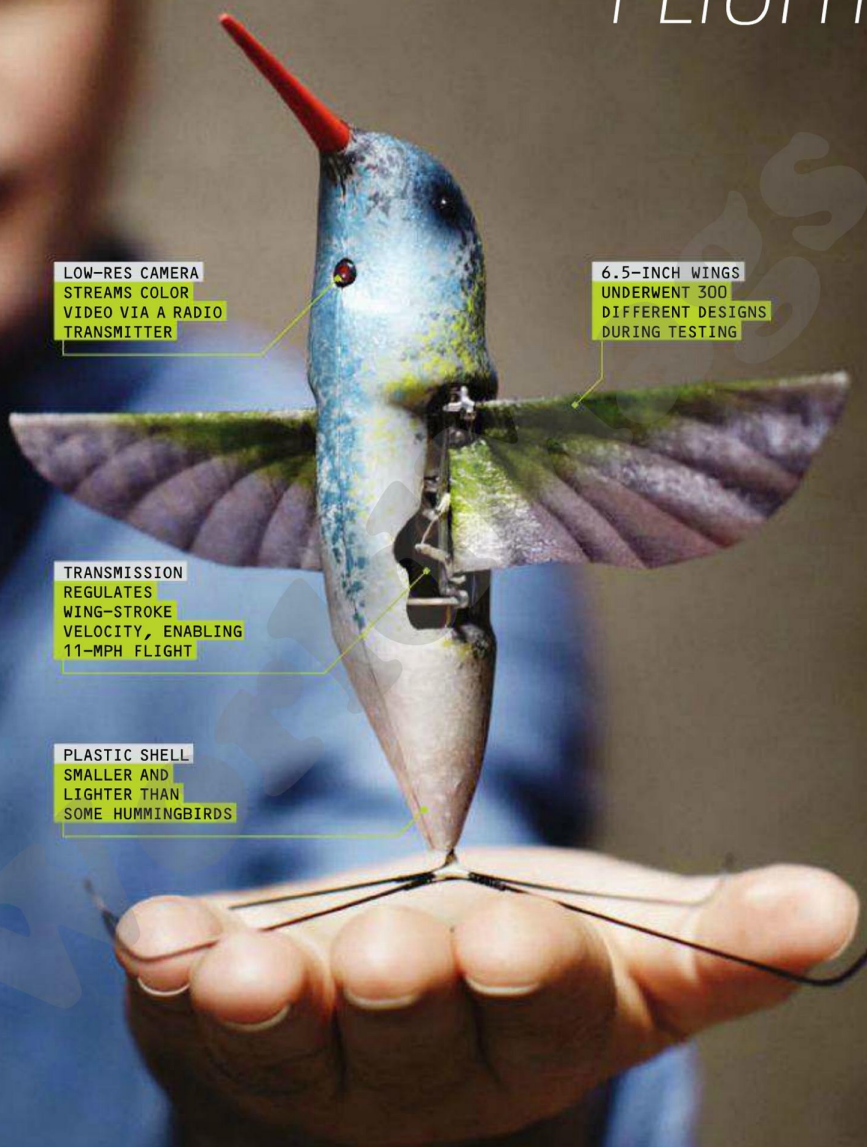
“I always liked fast, gas-guzzling race cars, so when I first heard the club was named the Hybrid X Team, I wasn't so sure, but I gave it a try,” says captain Stefon Gonzalez. “It definitely broadened my horizons, not just with cars but with things like public speaking, fundraising and networking.” The after-school program also helped the high school senior (and two other teammates) land a public-transit internship with the Southeastern Pennsylvania Transportation Authority.

“I call it the light-switch effect,” Hauger says. “This work truly enlarges the

students' vision for what they're capable of doing. We don't put them in a row of desks and lecture about fuel efficiency, biofuels or aerodynamics. We say, ‘Let's solve this problem together.’”

The students so impressed Edison2 founder and Automotive X Prize champion Oliver Kuttner that he asked them to build an electric version of his Very Light Car (VLC). The team hopes to operate a nonprofit after-school project that employs students to make and sell the EVLC kit car. “When they're done, they will have the world's most efficient electric car by a leap,” Kuttner says.

REIMAGINING FLIGHT



LOW-RES CAMERA
STREAMS COLOR
VIDEO VIA A RADIO
TRANSMITTER

6.5-INCH WINGS
UNDERWENT 300
DIFFERENT DESIGNS
DURING TESTING

TRANSMISSION
REGULATES
WING-STROKE
VELOCITY, ENABLING
11-MPH FLIGHT

PLASTIC SHELL
SMALLER AND
LIGHTER THAN
SOME HUMMINGBIRDS

THE ASSIGNMENT WAS daunting: Build a remote-controlled aerial vehicle; make it tiny but highly maneuverable; install a camera so that pilots can navigate it into buildings using only a live video stream; and model the craft after an actual bird. "There could be no thrusters, no propellers," says Todd Hylton, who oversaw the project for DARPA's Nano Air Vehicle program—just two wings that flap.

Matt Keennon, an engineer for California-based AeroVironment, led the team that met this challenge, building the first-ever robotic hummingbird. "As far as we know, this is a new form of man-made flight," says the lifelong model-airplane fanatic. Altering wing speed changes thrust, while slight modulations in wing angle send the craft zipping off in any direction. It can also hover in place against gusting wind. The team custom-built most of the aircraft by hand using machine tools, microscopes and an old-school Swiss watchmaker's lathe to fashion parts, including tiny flanged pulleys in the flapping-wing transmission. The whole craft, including motors, battery, communication systems and video camera, weighs less than a AA battery.

The Pentagon hopes the Nano Hummingbird will usher in a new class of aerial surveillance vehicles capable of identifying targets, collecting intel and locating hostages indoors, not just on the battlefield. Law enforcement agencies might also use the drone to gather evidence—during standoffs or drug raids, for instance—and for search-and-rescue missions. During last spring's nuclear meltdown in Japan, says Hylton, "it would have been great to have a small vehicle to fly into the reactors to see what was going on before sending in humans."

Matt Keennon holding the Nano Hummingbird, which can hover and fly in three axes of motion using only two flapping wings.

innovators

V. REGGIE EDGERTON & YURY GERASIMENKO UCLA
SUSAN HARKEMA UNIVERSITY OF LOUISVILLE
JOEL BURDICK CALTECH **ROB SUMMERS**

brilliant idea

AN ELECTRIC THERAPY THAT
 STIMULATES SPINAL NERVES,
 ALLOWING THE PARALYZED TO WALK

OVERCOMING PARALYSIS

A HIT-AND-RUN ACCIDENT in 2006 left Rob Summers paralyzed from the chest down, shattering the college baseball player's Major League prospects. But his injury—and his athlete's dedication—made him the ideal candidate for a one-of-a-kind experiment led by a scientific dream team. UCLA researchers V. Reggie Edgerton and Yury Gerasimenko had been studying the effects of electrical stimulation on the spinal cord in animals for decades. To test their theories in a human, they teamed with Susan Harkema, rehabilitation director at the Kentucky Spinal Cord Injury Research Center, and Joel Burdick, a CalTech bioengineer.

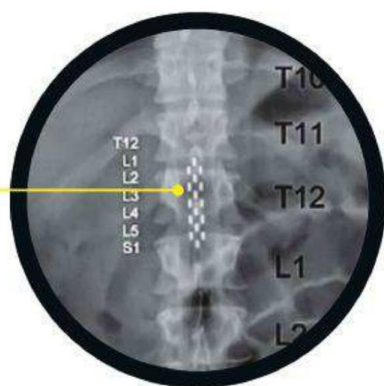
After preparing Summers with two years of physical therapy, the scientists implanted an electrode array over his lumbosacral spine, enabling them to send pulses of electricity directly to his spinal cord. This epidural stimulation amplifies motor commands to the injured area. The team believes it also activates local circuits of the spinal cord that can produce movement but that are not directly controlled by the brain. The spinal cord is “smart, and it's plastic,” Edgerton says. “That is, it can change. It can even learn motor tasks.” The bursts of electricity, combined with the repetitious movement of the locomotor training, may awaken neural circuits that send impulses to specific body parts. “This can happen without any input from the brain,” he says.

Summers, one of more than 1.3 million Americans who live with spinal cord

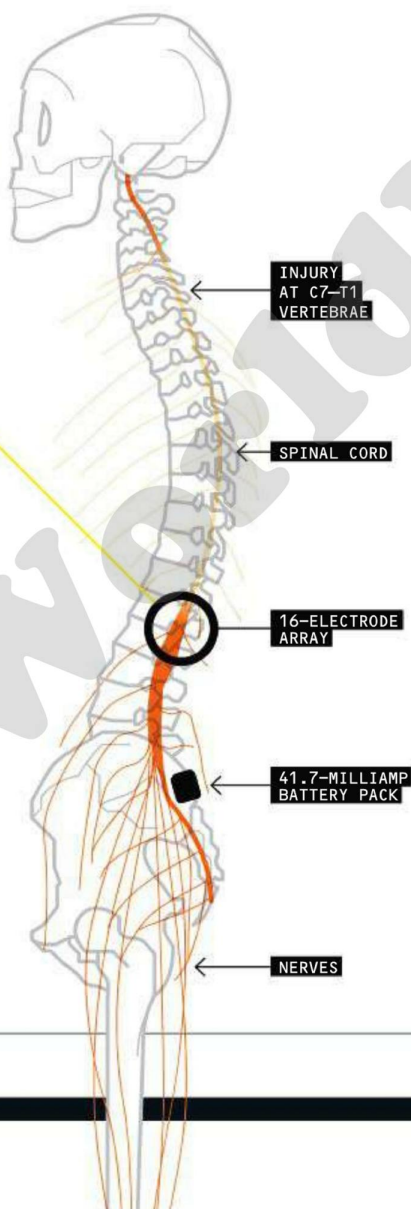
injuries, recovered unprecedented voluntary movement for someone with complete paralysis. “The third day they turned it on, I stood independently after not moving anything in four years,” he says. With stimulation, Summers can now bear his own weight for 4 to 25 minutes, move his toes, ankles, knees and hips on command and take a few steps on a treadmill. According to research published in *The Lancet*, he also resumed some bodily functions including the ability to sweat—which



The electrode array was implanted at Summers's T12 vertebra, stimulating his L1–S1 spinal cord segments.



enabled him to work as a guest pitching coach at a baseball camp in Florida. "Prior to that, my body couldn't handle the heat," he says. While the scientists, who have approval for four more human subjects, are cautiously optimistic, researchers from the University of Zurich were less reserved in a commentary that appeared in the same issue of *The Lancet*: "We are entering a new era when the time has come for spinal-cord-injured patients to move."



A flexible web of glass nanoparticles makes up each piece of Osorb. When it comes in contact with pollutants, the web opens up to encapsulate them, causing the Osorb to swell (inset).



innovator

PAUL EDMISTON COLLEGE OF WOOSTER, ABS MATERIALS

brilliant idea

MATERIALS SCIENCE

A POWDER THAT STRIPS NASTY CHEMICALS FROM WATER, OVER AND OVER AGAIN

TOXIC-WATER SPONGE

CHEMIST PAUL Edmiston has plenty of data to prove how well Osorb, a glass substance, soaks up petroleum, solvents and other organic contaminants. But he's most convincing when he mixes motor oil with water, adds Osorb, filters off the swollen powder, and drinks the remaining liquid. "It works like a nanomechanical sponge," he says. "I've done trace analysis, and the water's totally clean."

A graduate student of Edmiston's stumbled upon the material while experimenting with molecules for a bomb-detection device. After she added acetone to a beaker of silicas, they ballooned to eight times their normal size. She went straight to Edmiston, asking, "Did I mess up?"

Much to the contrary: The silicas, Edmiston realized, are hydrophobic, so they ignore water but grab both polar compounds (such as acetone) and nonpolar ones (such as

octane) out of solution. The contaminants can be released for disposal or recycling by squeezing the nanomechanical sponge—that is, by applying heat. The swellable glass can be reused more than 100 times.

Osorb could clean up a number of intractable environmental problems, from industrial accidents to the billions of gallons of wastewater produced by the boom in natural gas fracking (hydraulic fracturing). In a pilot test at a well in Ohio, a prototype system treated 60 gallons of water per minute, slashing its petroleum content from 227 milligrams per liter to 0.1 mg per liter.

A metal catalyst in a new version of Osorb goes one step further, breaking down contaminants to environmentally benign molecules. Stephen Spoonamore, Edmiston's partner in a startup called ABS Materials, describes it as "a catalytic converter that works on liquids instead of gases."

PHOTOGRAPH BY BEN GOLDSTEIN DIAGRAM BY DOGO

innovators

SPIRIT & OPPORTUNITY

ENGINEERING TEAM LED BY: STEVEN SQUYRES CORNELL UNIVERSITY
JOHN CALLAS, RICHARD COOK, PETER THEISINGER NASA JET PROPULSION LAB

brilliant idea

ROBUST ROBOTIC SURROGATES
FOR HUMANS ON MARS

MARS ROVERS

MECHANICAL
LIFETIME
ACHIEVEMENT
AWARD

SPEED WHEN ENTERING MARS ATMOSPHERE:

12,000 MPH

LENGTH: 5.2 FEET

WIDTH: 7.5 FEET

HEIGHT: 4.9 FEET

WEIGHT: 384 POUNDS

17 times heavier than Pathfinder

TOP LAND SPEED: AVERAGE LAND SPEED:

2.04 INCHES/SEC

OPERATING TEMPERATURE (F):

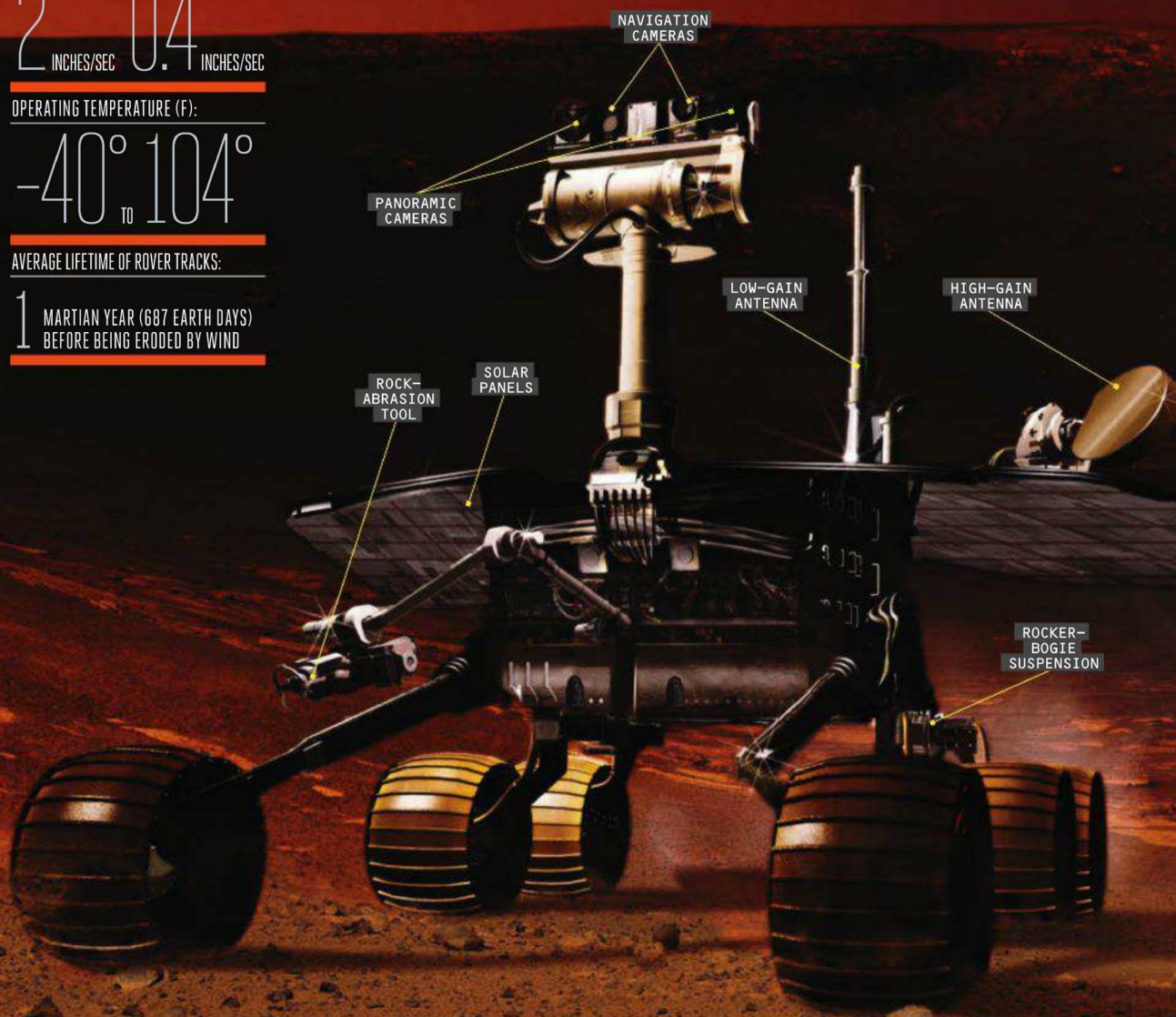
-40° TO 104°

AVERAGE LIFETIME OF ROVER TRACKS:

1 MARTIAN YEAR (687 EARTH DAYS)
BEFORE BEING ERODED BY WIND

FOR SIX-WHEELED, 400-POUND mechanical geologists, Mars rovers Spirit and Opportunity have really turned on the charm, working their way into the hearts of an admiring public—and, most powerfully, those of their engineers. “We just couldn’t be prouder of those little rovers,” says NASA’s deputy administrator, Lori Garver. After landing on Mars in 2004, each rover was meant to operate for 92 days and travel about three-quarters of a mile. Nearly seven years and 20 miles later, Opportunity still motors on. Spirit performed a feat of Martian mountaineering before finally running out of power on the darker, harsher side of the planet last year. To observers such as Daniel Wilson, author of *Robocalypse* and a PM adviser, “they’re a great example of the resiliency of robots and the ingenuity of humankind.”

If the rovers’ stamina wildly exceeded expectations, so have their discoveries: picture-postcard images from the surface of Mars, evidence that the planet once held water, footage of dust devils that offers insights into Martian wind. They also inspired the next generation of space explorers. This November, a new vehicle named Curiosity will be sent to the Red Planet to continue NASA’s Mars Exploration Program, which began in 1976 with the two Viking landers. It will drill into soil and fire lasers at rocks, analyze mineral samples and search for life’s carbon-based building blocks—work made possible by its intrepid twin predecessors. As John Callas wrote in a heartfelt goodbye to Spirit: “She has also given us a great intangible. Mars is no longer a strange, distant and unknown place. Mars is now our neighborhood.” For all that, brave rovers, we salute you.



SPIRIT

LAUNCH DATE: 06/10/03

FLIGHT DISTANCE:

303,000,000 MILES

LANDED:

01/04/04

LONGEST ONE-DAY ADVANCE: 406 FEET

SHARPEST INCLINE SCALED: 30.2 DEGREES

IMAGES RETURNED:

124,000

1: GUSEV CRATER

Spirit touches down as planned in the 95-mile-diameter Gusev crater, which scientists think may once have held an ancient lake.

2: SUMMIT OF HUSBAND HILL

08/21/05

TOTAL DISTANCE TRAVELED: 3.1 MILES

In pursuit of different rock types, Spirit climbs a hill roughly the height of the Statue of Liberty—becoming the first explorer ever to scale another planet's summit.

3: HOME PLATE

02/21/06

TOTAL DISTANCE TRAVELED: 4.1 MILES

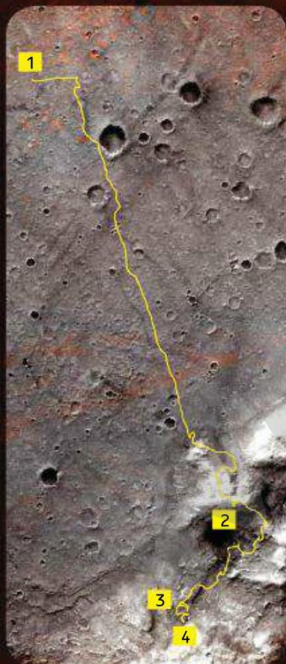
Spirit finds clues that an explosive volcano formed this rocky outcrop—and that water may have played a role in its creation.

4: TROY

05/01/09

TOTAL DISTANCE TRAVELED: 4.8 MILES

While driving backward, dragging a disabled front wheel, Spirit becomes mired in soft soil. The rover studies it until losing contact with NASA in March 2010.



3.13 MILES

OPPORTUNITY

LAUNCH DATE: 07/07/03

FLIGHT DISTANCE:

283,000,000 MILES

LANDED:

01/25/04

LONGEST ONE-DAY ADVANCE: 721 FEET

SHARPEST INCLINE SCALED: 31.2 DEGREES

IMAGES RETURNED:

155,671

1: EAGLE CRATER

After landing inadvertently in this crater on Meridiani Planum, Opportunity uses its rock-grinding tool. It discovers hematite, which forms inside deposits soaked with groundwater.

2: VICTORIA CRATER

09/27/06

TOTAL DISTANCE TRAVELED: 5.77 MILES

Opportunity explores inside this stadium-size crater, finding that water has come and gone there several times in the past.

3: BLOCK ISLAND

07/28/09

TOTAL DISTANCE TRAVELED: 10.7 MILES

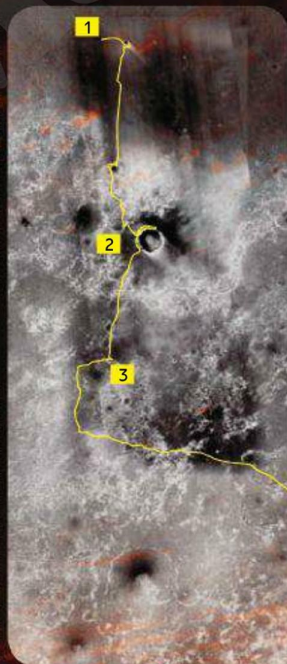
The rover finds and analyzes this watermelon-size, iron-nickel meteorite, which holds clues to the history of the Martian climate.

4: ENDEAVOUR CRATER

08/09/11

TOTAL DISTANCE TRAVELED: 20.8 MILES

Opportunity reaches Spirit Point on the rim of this 14-mile-wide crater—home to exposed rock outcroppings older than any the rover has yet examined.



12.07 MILES



ILLUSTRATION BY ALEXANDER VAN DAALLEN

innovator

PETER HOFBAUER
ECOMOTORS

brilliant idea

A HIGH-POWER, LOW-EMISSIONS
INTERNAL COMBUSTION ENGINEA BETTER
ENGINE

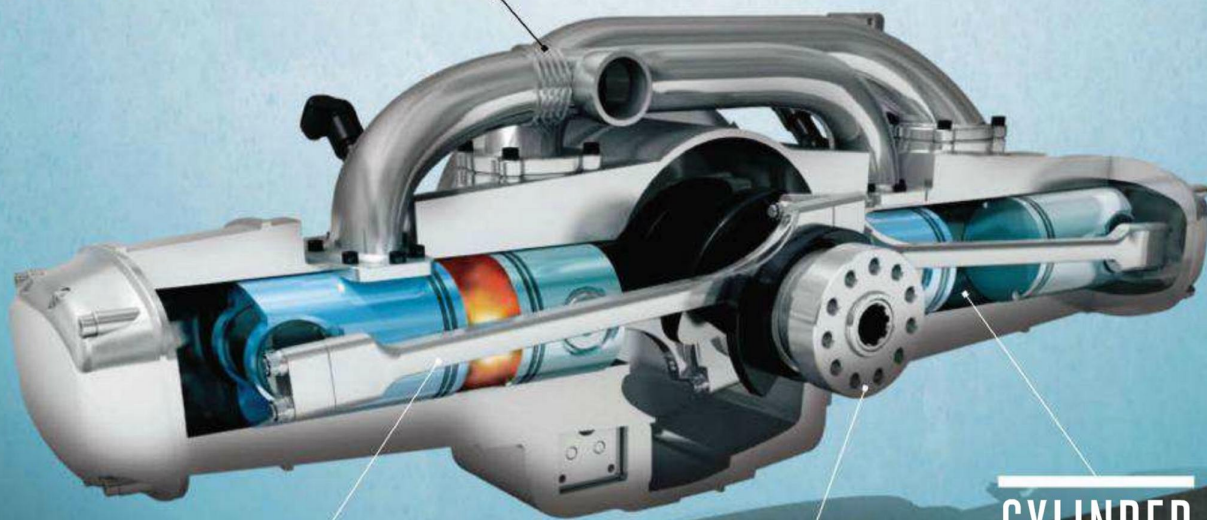
TURBOCHARGER

An electric motor mounted to the blower's shaft quickly spools the compressor for a fast boost; in reverse, it generates electricity off the exhaust flow. Plus, it manages exhaust pressure to minimize emissions.

RELATIVELY SIMPLE and lightweight, two-stroke engines (found in chain saws and outboard motors) would be great in cars and trucks, if they weren't so dirty. "I probably spent \$50 million of GM's money proving two-strokes don't work in automobiles," says General Motors veteran Don Runkle. The Opposed-Piston, Opposed-Cylinder (OPOC) engine developed by EcoMotors' Peter Hofbauer changed Runkle's mind so thoroughly that he became the company's CEO.

As in other flat engines (sometimes called boxer engines for the way their pistons resemble two fighters trading jabs), OPOC's pistons move horizontally. Hofbauer's aha! moment came one day when the former Volkswagen engineer was pondering the shortcomings of VW's boxer engine. "I thought, my God, if you just replace the cylinder head with a moving piston and cylinder ports, it might be less complicated."

It is—by a long shot. The engine requires less than half the parts of a similar four-stroke engine and is 30 percent lighter. The net result, says Hofbauer, is a 15 to 50 percent increase in energy efficiency, depending on the configuration. And thanks to its unique architecture and several key innovations, the OPOC releases far fewer emissions than a typical two-stroke. With a 240-hp diesel prototype, EcoMotors is focused now on the truck market; last February the company signed a licensing agreement with Navistar. "When the economy has recovered, the world will add 85 million combustion engines for cars and light trucks," Hofbauer says. "If we can offer an engine that is efficient and competitive in production costs, it will be a success."



STEEL CONNECTING RODS

Long steel connecting rods join the outer pistons to the crankshaft. With two pistons working off one combustion event, the engine behaves as though it has a long stroke—utilizing more of the available energy and increasing efficiency. Yet the crankshaft remains compact and therefore lighter.

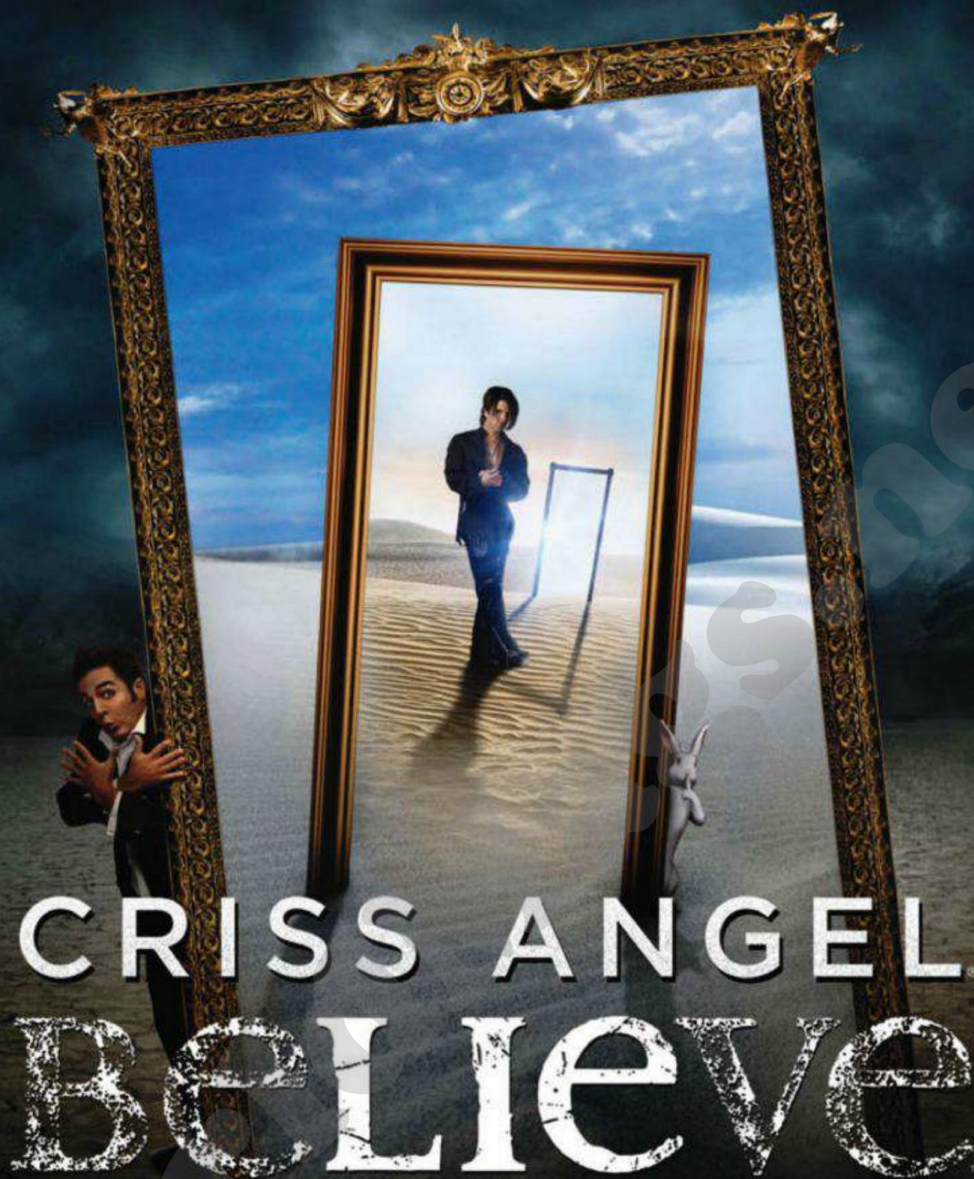
CRANKSHAFT

The engine is modular, and the crankshaft of the cylinder pairs can be connected by a clutch. For highway cruising, unneeded cylinders can simply be idled and then engaged again for passing.

CYLINDER

Gases flow in and out of the cylinder via ports in the walls, saving the complexity and weight of cylinder heads. The design of the intake and exhaust systems and combustion chamber keeps excess unburned fuel from exiting the exhaust port, reducing emissions.

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innovators

JULIANA BLUM, LAURA NIKLASON, SHANNON DAHL
HUMACYTE

brilliant idea

OFF-THE-SHELF BLOOD VESSELS
COMPATIBLE WITH ANYONE

READY-MADE BLOOD VESSELS

WHILE TRAINING IN an intensive-care unit during medical school, Laura Niklason got a graphic view of a persistent problem. "The surgeons spent a lot of time digging around in the patients' legs or arms looking for veins to replace main arteries," she says. "I thought, there's got to be a better way."

According to the most recent National Hospital Discharge Survey, doctors in the U.S. performed 408,000 coronary artery bypass procedures in 2007, all of which required vascular grafts. And more than half of the 320,000 chronic dialysis

patients need blood vessels transplanted into their arms. While tissue engineers can grow compatible vessels from a patient's own cells, the wait time can be more than six months. Niklason, along with colleagues Juliana Blum and Shannon Dahl, decided the solution should be at a surgeon's fingertips: Their company, Humacyte, was the first to make blood vessels that can be stored for future use.

To grow these, the researchers seed human smooth-muscle cells onto tubular scaffolds made from a biodegradable polymer.

The cells produce collagen and other molecules that form a matrix as the scaffold disintegrates. Using detergent, the researchers scrub away the muscle cells, leaving nonimmunogenic vessels behind—meaning they won't be rejected by an unrelated patient's body.

"Think of [the vessel wall] as a sponge," Dahl says. "It has holes that are filled with cells. Wash them away and you're left with something you can still hold on to."

The vessels retained their strength and elasticity after a year of refrigerated storage in a saline solution, according to a study published in February's *Science Translational Medicine*. They were then grafted into animals, where, after six months, they showed

no signs of fibrosis or thickening of the vessel walls.

"Since vascular disease is really the No. 1 cause of morbidity and mortality in the Western world, a way to replace diseased arteries will have huge impact, I hope, over the long term," Niklason says, "particularly with the problem of obesity."

Humacyte hopes to begin human trials overseas in 2012; meanwhile, the team is already thinking beyond blood vessels. The same technique could be used to grow other simple tissues, such as ligaments and cartilage, that are structurally important. Eventually, they think, labs will grow organs with complex functions—making more transplants off-the-shelf.

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iPod not
included.

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The Connect Kit plays music from and charges most iPod and iPhone models. In the event of audio interference, set iPhone to airplane mode. *Bose payment plan available on orders of \$299-\$1500 paid by major credit card. Separate financing offers may be available for select products. See website for details. Down payment is 1/12 the product price plus applicable tax and shipping charges, charged when your order is shipped. Then, your credit card will be billed for 11 equal monthly installments beginning approximately one month from the date your order is shipped, with 0% APR and no interest charges from Bose. Credit card rules and interest may apply. U.S. residents only. Limit one active financing program per customer. ©2011 Bose Corporation. The distinctive design of the Wave® music system is a registered trademark of Bose Corporation. Financing and free Connect Kit offers not to be combined with other offers or applied to previous purchases, and subject to change without notice. If the system is returned, the Connect Kit must be returned for a full refund. Offers are limited to purchases made from Bose and participating authorized dealers. Offers valid 10/1/11-11/19/11. Risk free refers to 30-day trial only, requires product purchase and does not include return shipping. Delivery is subject to product availability. iPod and iPhone are registered trademarks of Apple Inc. Quotes reprinted with permission: Thomas Jackson, *Forbes* FYI, Winter/04.

BOSE
Better sound through research

innovators

**CORWIN HARDHAM,
KENNY JENSEN,
DAMON VANDER LIND**
MAKANI POWER

brilliant idea

A TURBINE THAT GOES
WHERE THE WIND
IS—THOUSANDS OF
FEET OFF THE GROUND

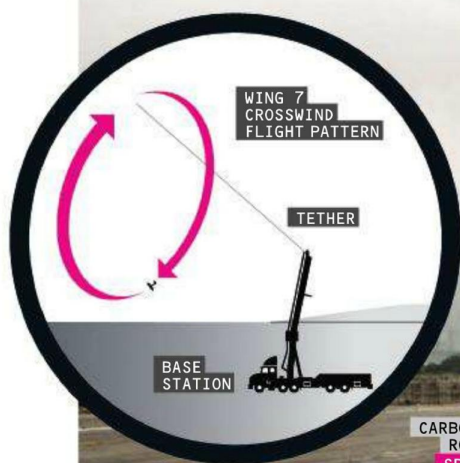
HIGH
FLIERS

AS A KITE BOARDER, zipping back and forth across the surf, Corwin Hardham experienced firsthand the power of wind. As an engineer, he wanted to harness that energy with the ease and flexibility of the sport. Makani Power, which Hardham co-founded, now leads a small pack of startups eagerly attempting to tap into an unexploited resource—the strong, consistent winds blowing above 1300 feet.

To do so, Hardham, with engineers Kenny Jensen and Damon Vander Lind, did away with 90 percent of the mass of a conventional turbine—namely, the tower—and instead mounted Makani's

technology on a glorified string. But rather than resembling a kite, the sleek, 20-kilowatt Wing 7 prototype is equal parts airplane, helicopter and robot.

Weighing a mere 130 pounds and spanning 28 feet, Wing 7 takes off vertically with rotors up, rotates into horizontal flight and autonomously flies in swooping circles. Wing-mounted turbines generate electricity, transmitting it to the ground through the tether. A first-of-its-kind vertical tail wing allows the craft to transition through the various flight modes, Hardham says: "It's a whole new take on aviation."



**CARBON-FIBER
ROTORS**
SPIN AT
4000 RPM

**MOTOR
PYLONS**
HOLD MOST OF
THE WING'S
ELECTRONICS
AND AVIONICS

**CARBON-FIBER
WING**
GENERATES
20 KILOWATTS
OF POWER IN
22-MPH WINDS

STABILIZER
ALLOWS 90-DEGREE
ROTATION FROM
VERTICAL TAKEOFF
TO HORIZONTAL
FLIGHT

Standing with Wing 7, from left, control systems engineer Kenny Jensen, CEO and CTO Corwin Hardham and systems engineering lead Damon Vander Lind.

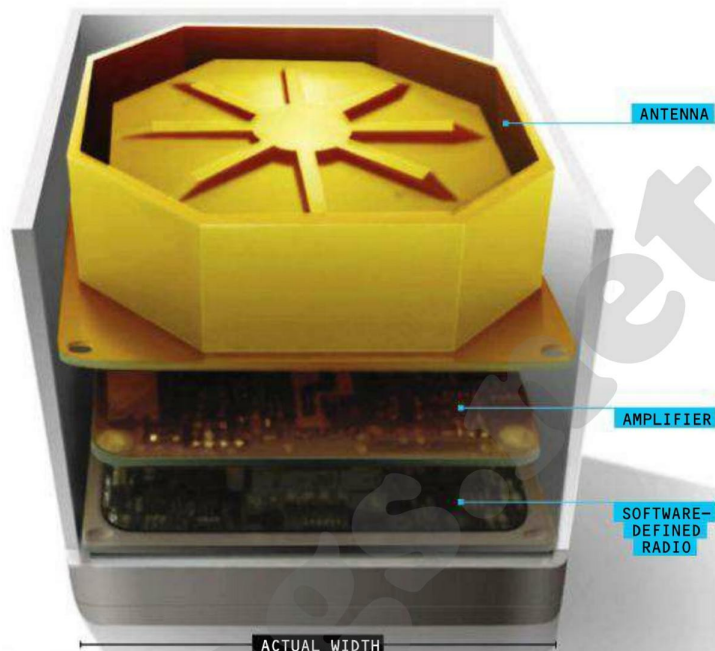
Eventually, fleets of autonomous, power-producing craft may be tethered to land or to buoys at sea.

With funding from the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E)—as well as from venture capitalists such as Google founders Larry Page and Sergey Brin—Makani plans to develop a 1-megawatt unit by 2013 that can fly above 1800 feet, with hopes of taking it to market two years later. The company's ultimate goal is to tap the jet streams above 23,000 feet, which contain roughly 100 times the energy currently used worldwide.



PHOTOGRAPH BY PHILLIP TOLEDANO

ILLUSTRATIONS BY ALEXANDER VAN DAALEN (LIGHTRADIO CUBE), DOGO (WIND TURBINE)



innovator
TOD SIZER BELL LABS

COMMUNICATIONS

brilliant idea
BROADBAND BEAMED BY A RUBIK'S CUBE

A TINY CELL TOWER

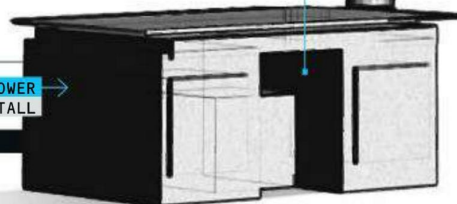
WITH PREDICTIONS of a thirtyfold increase in mobile data demand by 2015, Tod Sizer, head of wireless research at Bell Labs, knew something had to give. "There's no way we can put up 30 times as many cell towers as there are today," he says. So he did what any high-tech engineer would do—he went to his wood shop. Sizer cut a 60-mm cube, attached an aluminum plate to represent an antenna and handed it to his team, telling them to rethink everything.

Their solution, the lightRadio cube, drastically shrinks the antenna and combines it with an amplifier to boost the signal. Digital-processing functions, which currently hunker in a building at a cell tower's base, will be consolidated in facilities up to 25 miles away. Sizer compares this Lego-block approach to multicore computer processors. "The future," he says, "is not about higher- and higher-power solutions. It's about lower-power solutions serving a smaller number of people with the same amount of data." According to the company, arrays of the cubes—affixed to skyscrapers, airport terminals, bus stops—can increase broadband capacity by 30 percent while cutting operation costs and energy consumption in half.

The lightRadio cube won't topple all towers—they'll still be needed along roadways and in rural areas—but it should greatly reduce their proliferation. It should also revolutionize cellphone service in the cities of resource-strapped developing countries.

LIGHTRADIO CUBE →
60-MM SQUARE

TRADITIONAL CELL TOWER →
93 FEET TALL



innovator
ELON MUSK
 SPACE X

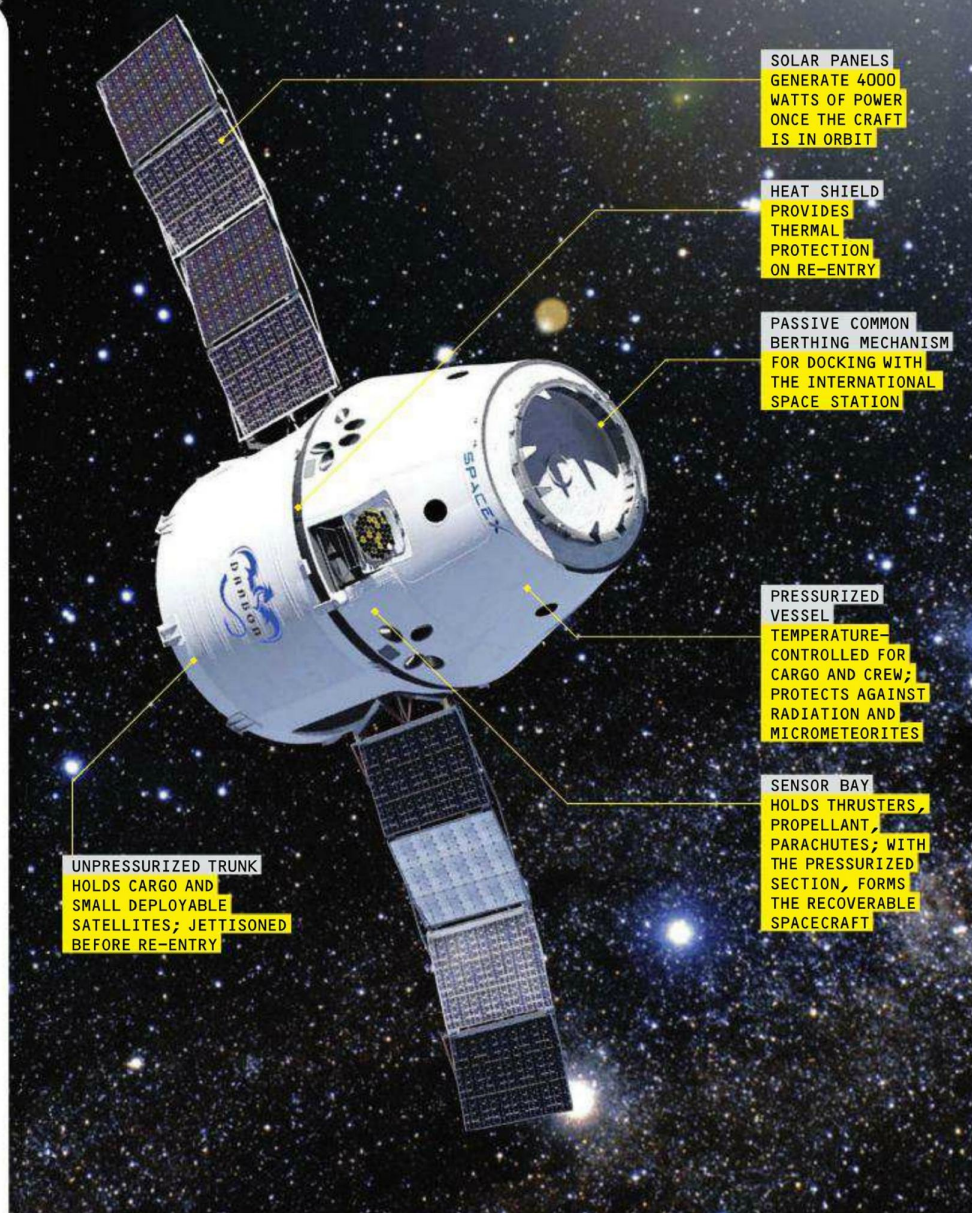
brilliant idea
 A SPACECRAFT THAT CAN DELIVER
 BETTER PERFORMANCE AT LOWER COST

LAUNCHING PRIVATE SPACEFLIGHT

IT'S BEEN a stellar 18 months for SpaceX. The aerospace company signed a \$492 million launch contract—the largest in history—with satellite company Iridium Communications. It received a \$75 million slice of NASA pie to develop an escape system for its Dragon spacecraft. And in December, it became the first private company ever to launch a craft into orbit and successfully recover it: After circling the Earth twice, the unmanned Dragon splashed down within a mile of its target in the Pacific Ocean.

"I think it's important that humanity try to become a multiplanet species," says SpaceX founder and CEO Elon Musk. "If we're not steadily improving our access to space, making it more reliable at lower cost and at larger scale, that will never happen." The company says the Dragon capsule will be able to lift seven astronauts into orbit atop its Falcon rocket—more than double the capacity of the Russian Soyuz, at less than one-third of the price per seat.

NASA engineer and 2010 Breakthrough Award winner Daniel Andrews calls SpaceX's achievements "necessary and impressive," poised to create "very real, high-tech jobs in a new market sector." In fact, at press time, SpaceX advertised 130 open positions.



The Dragon's first cargo delivery to the International Space Station is planned to launch Nov. 30; the first manned mission in 2014.

AN ELECTRIC CAR. NO ELECTRICITY FOR MILES. HERE'S WHERE IT GETS INTERESTING.

You know that thing about electric cars where they run out of charge and leave you stranded in the middle of nowhere? The Chevrolet Volt doesn't do that. That's because the Volt has an on-board gas generator, so you can drive up to 35 miles gas-free, and up to 375 highway miles with a full charge and a full tank of gas. It's electric when you want it, gas when you need it. Learn more at ChevyVolt.com. It's more car than electric.*



*EPA-est. 94 MPGe (electric); 35 city, 40 hwy MPG (gas). Actual range varies with conditions. Available to order at participating dealers. Quantities limited.

2012 Chevrolet Volt. Chevy Runs Deep



THE YEAR'S 10 MOST TRANSFORMATIVE PRODUCTS



MOTOROLA ATRIX 4G

● The Atrix 4G is a topnotch smartphone, with a dual-core Tegra 2 processor, 4G wireless speeds and a super-sharp 540 x 960-pixel screen. But what makes it revolutionary is a hidden talent: It's also a computer. When connected to the Motorola Lapdock, the Atrix switches modes—and becomes the heart, soul and brain of an 11.5-inch laptop. With the Atrix, Motorola has taken the first step toward a future in which one device serves as the nerve center of many. **(\$100)**

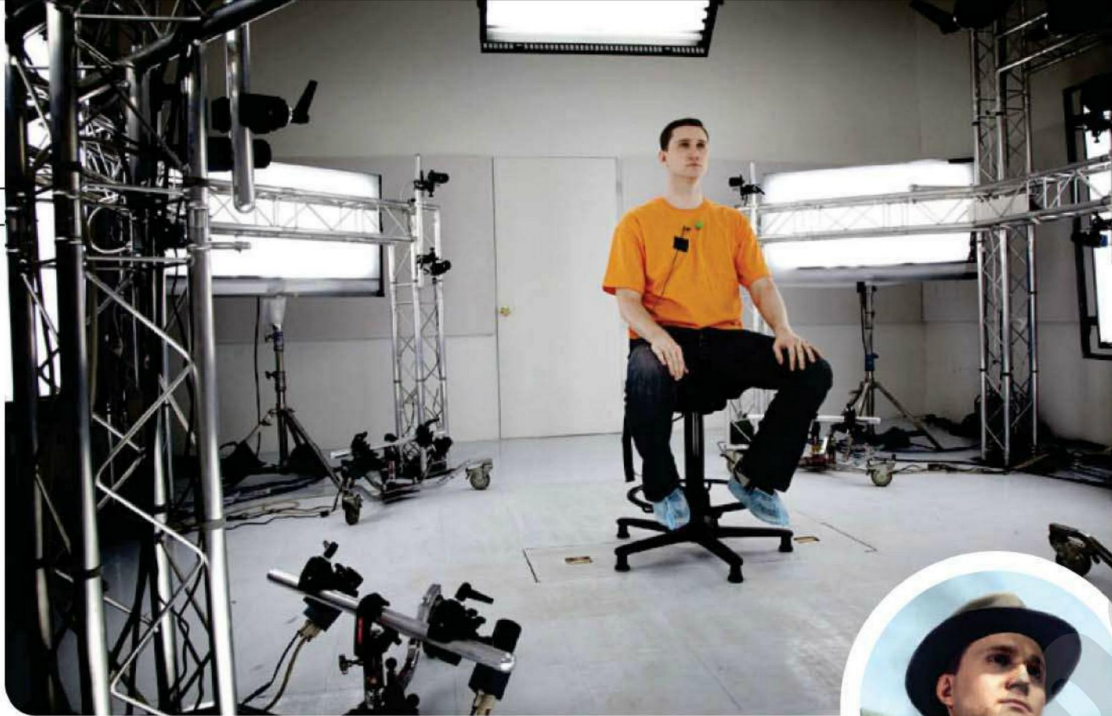
Square Reader, Square & Card Case Apps

● Turning an idea into a business is hard enough without having to deal with the byzantine rules of merchant banking. Square, co-founded by Twitter's Jack Dorsey, makes accepting credit card payments as easy as setting up an email account. With Square's card reader and associated apps, any iPad, iPhone or Android handset can process transactions on the spot. Signatures register on a touchscreen, and receipts go out via email. Square's eponymous new app turns mobile devices into full-fledged point-of-sale terminals with a visual inventory; Card Case further simplifies the process, storing payment info in a secure app to allow wireless, instant purchases at Square-ready stores. **(Free, plus 2.75 percent of each transaction)**

Microsoft Kinect for Windows Software Development Kit

● As a gaming device, Kinect was a hit. PM gave its user interface, Project Natal, a Breakthrough Award in 2009. But it wasn't until hackers got their hands on the motion-control technology for Xbox 360—with its infrared camera, laser depth sensors and microphone array—that Kinect's true potential emerged. UC Davis students used the depth sensors for 3D video conferencing; at the University of Minnesota, Kinect became a tool for identifying ADD, OCD and autism in kids; Microsoft even demonstrated a lounge chair propelled and steered with hand gestures (right). In the software development kit, Microsoft not only sanctions hacking, it provides programmers, researchers and artists with the tools to do it. That's the kind of breakthrough-enabling attitude we love. **(Free)**





Rockstar Games' *L.A. Noire*

- It's the video game that could provide a definitive response to the question, can games be art? Cinema-grade MotionScan technology allows actors, such as *Mad Men*'s Aaron Staton (seated), to actually *play* their characters (inset), giving Rockstar Games' *L.A. Noire* an exhilarating level of realism. A detective's brow furrows in frustration. A witness's lips purse. When suspects lie, it's revealed in the lines of their faces. The effect is at once uncanny and cinematic—and certainly unprecedented. Gamers will never look back. **(\$50)**

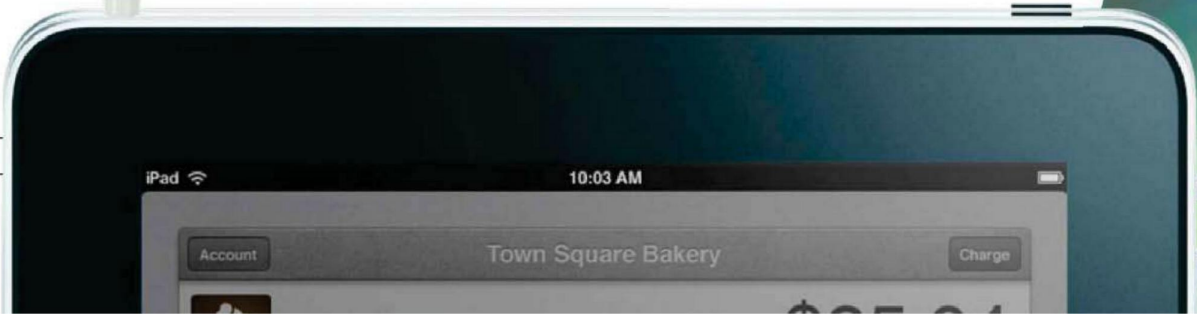


Parrot Asteroid Receiver

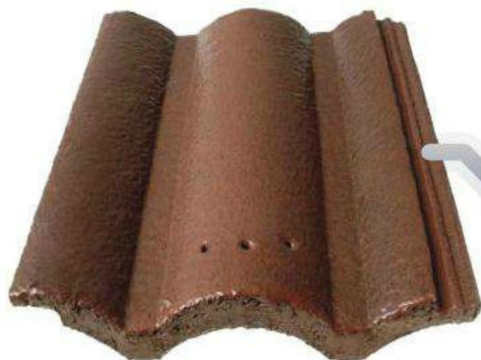
- According to consumer marketing firm R.L. Polk, the average age of cars and trucks on the road today is about 11 years. In tech terms, that's an eternity. The Asteroid, Parrot's drop-in receiver, is a simple way to turn any older model into a connected vehicle. Powered by Google Android software, the Asteroid includes voice recognition, hands-free calling and connections for popular smartphones and media players. It also supports 3G mobile Internet, enabling apps for navigation, Internet radio and, well, anything else developers come up with. **(\$350)**

Ford Rear Inflatable Seat Belts

- Seatbelts haven't changed dramatically since the introduction of the three-point model in 1959, that is, until Ford combined rear belts with another important safety feature: the airbag. Available as an option in the 2011 Explorer, the belts activate with compressed gas via a specially designed buckle. As it breaks through the fabric, the airbag provides support for more than five times the body area of a normal belt. This reduces pressure on the chest and further secures the neck and head during an accident, especially important for children and older passengers. **(\$595 as part of a safety package)**



BORALPURE SMOG-EATING TILE



- Using some creative chemistry, Boral Roofing has turned a standard building material into a formidable weapon—not just against sun and rain, but also air pollution. The tile's coating contains TiO_2 (titanium dioxide), which reacts with and neutralizes NO_x (nitrogen oxide) particles in smog. The byproduct is a harmless precipitate that accumulates on the roof and washes away in the rain. That's pollution removal at its best. No machinery. No moving parts. No energy input other than sunlight. Just a clever, air-cleansing chemical reaction.

(Price: 25 percent above cost of standard roofing)

Solaria Photovoltaic Panels

- Solar power has a problem. In order for people to make the switch, solar technology needs to be cheap. The silicon required for standard photovoltaic (PV) panels, however, is extremely expensive. Solaria struck upon an elegant solution with its monocrystalline panels: Use 50 to 70 percent less silicon. Rather than covering the entire module with PV panels, Solaria leverages a patterned-glass lens to refocus light onto a strip of solar cells. The module is durable; the proven operating life is longer than 25 years. And because the product uses the supply chain already established in traditional solar panel manufacturing, overall costs remain low. **(Price: one-third less than a solar panel of comparable efficiency)**



Philips AmbientLED Bulb

- The AmbientLED is the first credible LED replacement for the most common light bulb in America, the 60-watt incandescent—and it hits shelves just in time for new federal efficiency standards. At 800 lumens, the bulb is just as bright as its tungsten counterpart but consumes only 12.5 watts of power. And after hours of operation, it's merely warm to the touch. Philips's secret lies in remote phosphor technology, which generates a pleasing hue and diffuses light to create that familiar soft glow. One thing that may take some getting used to is the bulb's longevity: The AmbientLED is rated to burn for 25,000 hours, 25 times longer than a typical incandescent. **(\$25)**



SkyProdigy Automatic Telescopes

- Contrary to what the name suggests, most "automatic" telescopes require calibration, and so take time and expertise to master. "Many people don't have that kind of dedication," says Eric Kopit, Celestron's director of development. The company's SkyProdigy series—which includes refractor, reflector (130-mm, left) and Maksutov-Cassegrain-style models—makes looking into the cosmos truly effortless. With built-in tracking cameras and a digital database of more than 4000 heavenly objects, the SkyProdigy telescopes sight themselves in less than 3 minutes, so even a first-time stargazer can experience the thrill of discovery. **(\$699–\$799)**



Cub Cadet®

FUTURE VISION CONTEST

CONGRATULATIONS TO THE TOP FIVE

FUTURE INNOVATIONS FROM CUB CADET


Utility Vehicle concept ▲



Zero-Turn Rider concept ▲


John W. ▲
 New Albany,
 Mississippi

Dana E. ▲
 Humble, Texas

Seph A. ▲
 Oxford, Mississippi

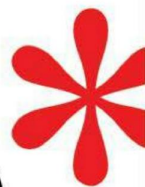
Shannon L. ▲
 Live Oak, Florida

Zheng X. ▲
 Tempe, Arizona


Thanks to all who celebrated Cub Cadet's 50 years of innovation with your ideas for the future of outdoor power equipment. An expert panel selected their Top 50 and you voted for the most innovative idea of all. Congratulations to the Top 5 innovative ideas. To learn more about the Cub Cadet Future Vision Contest entries and Cub Cadet's innovative products visit **www.cubcadet.com/next50**

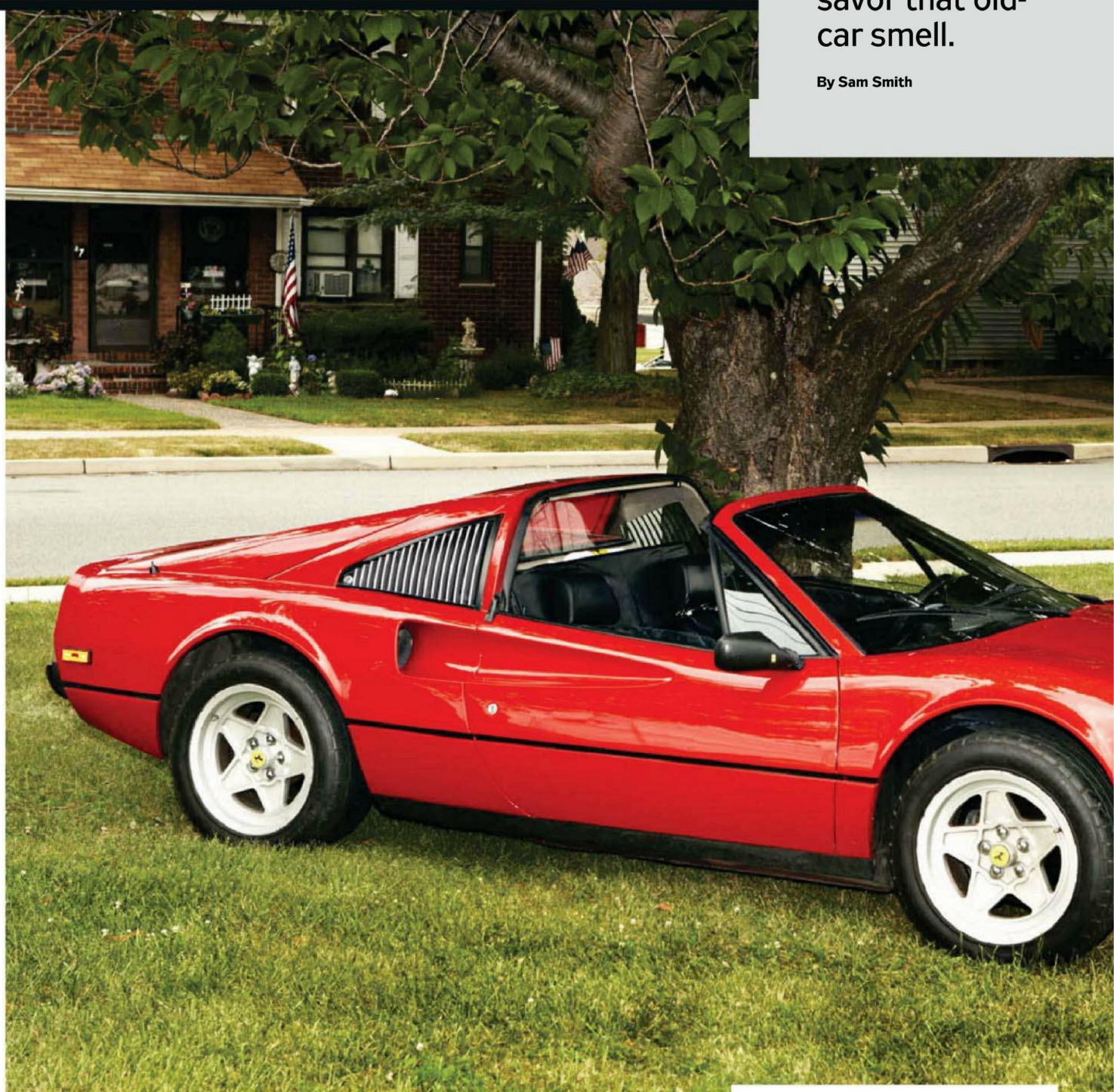
Cub Cadet®
 FIFTY 50 YEARS
SINCE 1969
Popular Mechanics

Steal this car...



Pre-owned cars are more affordable, more reliable and more enjoyable than ever. Time to savor that old-car smell.

By Sam Smith



For the Price of a Loaded Camry

PHOTOGRAPHS BY GUIDO VITTI

Ferrari 308/328

1975 to 1989



Why It's Cool

It's a midengine Ferrari for the price of a family sedan. Even if the Ferrari is slower in a straight line (which it is), how can you pass that up?

What It Says

"I can afford a Ferrari. Would you like to see my Ferrari? Look, Ma, I've got a Ferrari!"

Speed Bumps

Terrible ergonomics; interior known primarily for Playskool switch-gear and dime-store quality. Cam-belt service can approach \$8000. Low price of entry often results in neglect by cheapskate owners.

Why You Want It Anyway...

Three words: Magnum, Private Investigator. Also, it sounds like a Ferrari, aka a wicked wail.

Alternative

1997 to 2004 Corvette C5: if you can get past the Rubbermaid interior.

Price Range

\$20,000 to \$40,000



MARK THESE WORDS: We are living in perhaps the last great era of the automobile. If you account for inflation, cars have never before been—and may never again be—faster, cheaper or more comfortable than they are now. Waltz into your Chevrolet dealer, you can buy a

638-hp Corvette for \$110,300 that cushions like a Cadillac. March down the street to the local Ford shop, you can have a \$13,995 Fiesta that rides and handles better than many cars costing twice as much. Win the lottery, a 253-mph Bugatti Veyron that costs \$1.7 million can be yours, and it won't even misbehave in traffic.

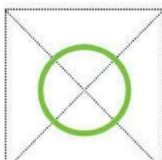
Admittedly, that last one is a bit out of reach for most. But progress trickles down. Computer-aided design, digital engine management and rustproofing have been around for decades, and the nation's used-car market is littered with durable, low-maintenance machines. Yesterday's sport sedans, luxury liners and even exotics are now available for pennies on the dollar. Most still have thousands of miles left to give. In a nutshell, this glut of old steel is the best thing to happen to the car freak since cheap oil.

History is replete with automotive golden eras. The period following World War II was arguably a high point, giving us lust-worthy and affordable sports cars, V8 muscle, even head-turning family sedans. When those machines hit secondhand lots, they fueled the engine of America's burgeoning speed culture. Suddenly, style and burned rubber were dirt-cheap.

Only the sweet deals didn't—some would say, couldn't—last forever. Classic cars have always been expensive, but in recent years, those postwar masterworks climbed to new heights. Baby boomers got older and wealthier. The cars of the '50s, '60s and early '70s were canonized, and because the supply was and is finite, more people with money began clamoring for a piece of a shrinking pie. Everyone wanted the same stuff, the cars that films such as *Vanishing Point*, *The Italian Job* and *American Graffiti* made famous.

This is how we ended up with \$70,000 Chevrolet Bel Airs and million-dollar Plymouth Hemi 'Cudas. And because a rising tide floats all boats, it's also what gave us \$25,000 Triumph TR6s and \$50,000 BMW 2002s. Maybe you think these cars—sprightly and fun when new—are worth big money. Maybe you light your cigars with hundred-dollar bills. We do neither.

Part of the blame belongs to circumstance. The machinery in question was glorified for a reason; it was stylish, fun to drive and historically important. But the new cars that followed, the ones that took their place at the low-buck end of the classifieds, stunk. Blame ballooning federal regulations or an industry slow to change with the times, but most cars of the 1970s and early 1980s were horrible. As the selection of interesting iron shrunk, more people turned to the rides their fathers and grandfathers lusted



after. Prices continued to rise, and the classic-car hobby grew stagnant.

Only now there's movement. Museum pieces are out; enjoyable drivers and low investments are in. The signs are everywhere, from cheap-classic websites such as bringatrailer.com to the rise of low-cost clunker racing à la 24 Hours of LeMons. The generation born in the 1970s is now old enough to have disposable income, and the obvious answers—the Bel Airs, the Austin Healeys—are too expensive, too temperamental. But thrillingly, the cars of *this* generation's youth are affordable. Thanks to modern technology, they're also still running, still safe, still practical.

To wit: The modern speed demon can buy and modify a 20-year-old, 150,000-mile BMW or Porsche that will shame many new sports cars. The luxury freak can have an old Jag that drives almost as well as a modern Lexus, with functional HVAC, three-digit capabilities and leather seats. Heck, even a mid-'90s (C4 or C5) Corvette is the perfor-

mance bargain of the century. Where else can you find a reliable 170-mph car for the price of a new Honda Civic?

This has only recently become possible. Thirty years ago, the average 10-year-old car was falling apart, with a worn-out carburetor, rusty body and nonexistent interstate manners. You could live with cars like this, but it took a certain amount of masochism—or at the very least, the weekly use of tools. The 1980s were a turning point, when the mass-produced automobile was advanced enough to last for decades with just regular maintenance, yet still simple enough to be repaired by the home mechanic. It was a nexus of light

weight, usable performance and relatively low emissions.

Call it the first real appearance of the modern car. And now this stuff is cheap.

Not that the market is all wine and roses—there are, and will always be, bad ideas. No one needs a 150,000-mile \$5000 BMW 750iL. (Rather, no one needs to pay to fix its complex V12.) No rusty \$500 Toyota Supra Turbo is a good idea. Sound judgment matters, just as it does with any other purchase. Caveat emptor.

Still, there are countless options that make sense. We've outlined a few for you here, but this is the tip of the iceberg. Welcome to the party, and happy hunting!



Exotic

Porsche 944

1983 to 1991

Price Range

\$4000 to \$12,000



Why It's Cool

It's a Porsche, albeit a front-engined one that shares components with period Audis. Nimble, durable, lots of storage space. Cheaper than the floor mats in a new 911.

What It Says

"I enjoy sausages, Kraftwerk and blowing exhaust smoke into the faces of air-cooled-Porsche purists."

Speed Bumps

Timing-belt breakage means certain engine death. Sardine-can driveline packaging and obnoxious parts pricing means maintenance is expensive. Turbo models don't feel as fast as they cost.

Why You Want It Anyway...

Speedy enough to get you into trouble, reliable enough to help you get out of it. In the right hands, it will embarrass a 911. Perpetually proletarian.

Alternative

1976 to 1989 Ferrari 400/412: the greatest V12 Cadillac Eldorado Detroit never built.

Mazda Miata

Price Range
\$1000 to \$7000

1990 to 1997



Cheap & Cheerful

Why It's Cool

Imagine a 1960s Lotus designed by the same people who brought you reliable modern electronics and the immersive video game. The playful promise of every British sports car ever made—actually fulfilled.

What It Says

"Really, I'm comfortable with my sexuality. No, I don't want a wedgie. Please, can we stop with the wedgies?"

Speed Bumps

The engine (115- or 131-hp I4) produces less power than the average household blender. Amateur road racers are snapping up all the good ones. Seat fabric is famously less than durable, and it's tough to source replacements.

Why You Want It Anyway...

Few cars this cheap handle this well. And if snickers from strangers make you feel insecure, you can always just tell them you're borrowing your wife's car.

Alternative

1982 to 1993 Alfa Romeo Spider: hopelessly anachronistic, but butch in a '70s funk kind of way.

BMW 3 Series

1984 to 1991

Why It's Cool

Good at everything, from long trips and grocery runs to track days. Astonishingly durable. Gloriously anonymous speed partner.

What It Says

"Officer, this car is 20 years old. I don't even think it goes that fast."

Speed Bumps

As with the Porsche, a broken timing belt can lunch the engine. Good performance plus low cost and durability means most examples now have over 200,000 miles. The cooling system is a weak point on early models.

Why You Want It Anyway...

You need a car that will do it all, but you don't want to pay for it. Also, there's a rare but stunning M3 version (left) with a 192-hp four-cylinder.

Alternative

1980 to 1987 Audi 4000CS Quattro: essentially Audi's legendary '80s Quattro coupe with four doors.

Price Range
\$2000 to \$15,000

Price Range

\$2500 to \$7000

Cadillac STS

1992 to 1997

Why It's Cool

Big, fast and gifted with GM's trick overhead-cam Northstar V8. Interior like an overstuffed couch. Front-wheel drive, so it's not hopeless in the white stuff.

What It Says

"What's wrong with getting old? Is there an Old Country Buffet around here?"

Speed Bumps

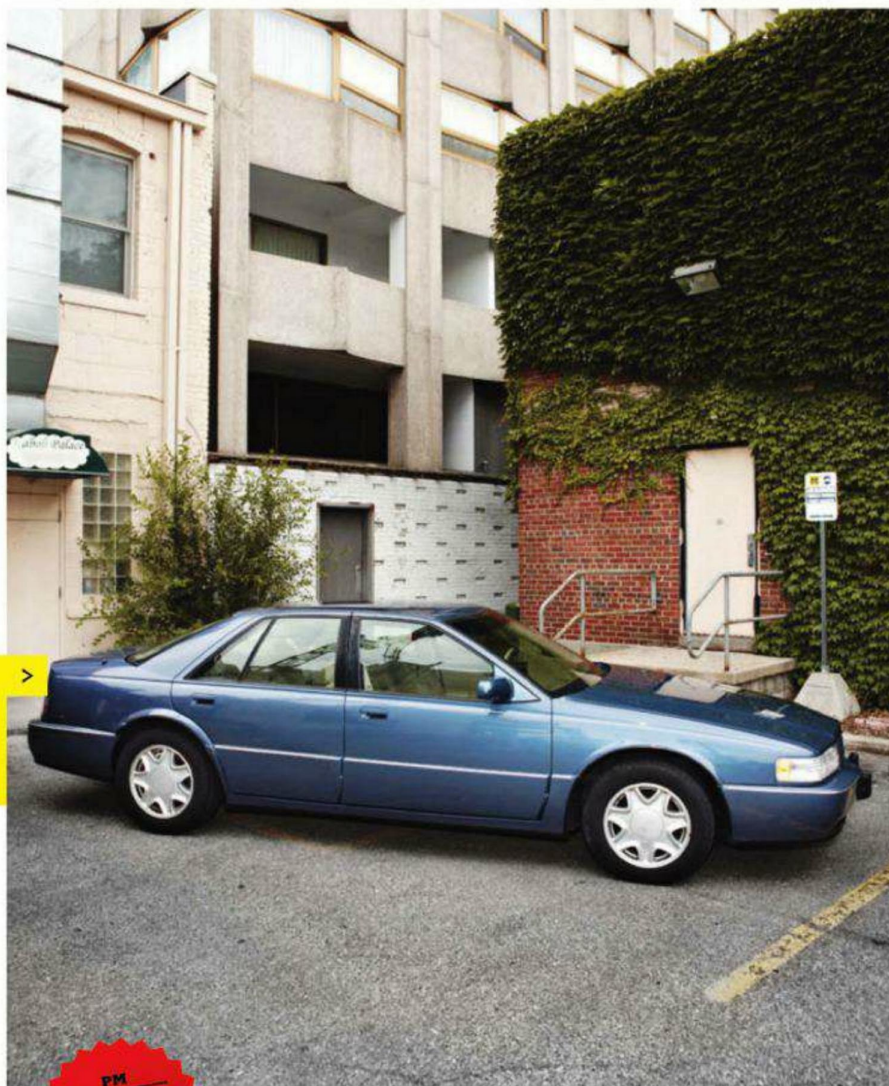
Cooling and oiling systems are weak points. The line "Hey, baby, wanna see my front-drive Cadillac?" is as appealing to the opposite sex as "My new dentures fit perfectly!"

Why You Want It Anyway...

The dash can be turned into an onboard scan tool. It lets you watch engine parameters in real time and check and clear codes. Lends an air of quirky, senior-citizen dignity to anyone.

Alternative

1990 to 2002 Lincoln Town Car: limousine, rental car, American icon.



Jaguar XJR

1995 to 1997

Why It's Cool

Feels like wealthy love, yet does killer burnouts. Acres of wood and leather, and a buttery ride-and-handling balance. The last high-po Jag to use the brand's creamy (and supercharged) inline six.

What It Says

"Luxury is worth paying for, even if you pay for it over and over again. Can I borrow five bucks?"

Speed Bumps

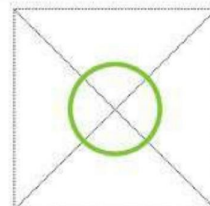
Factory parts can make Ferrari bits look like bargains. Electrical problems are endemic. It will depreciate like mad, no matter how much money you dump into it.

Why You Want It Anyway...

Because it's a Jaguar. And—even if you're pushing it down the street—everyone feels better in a Jaguar.

Alternative

1992 to 1998 Mercedes-Benz S-Class: autobahn cruiser extraordinaire.

**Price Range**

\$4500 to \$10,000

Why It's Cool

The first Benz to introduce the chiseled, taut body. Feels like it was carved from a solid metal slab. Somehow appeals to both the counter-culture and the upper class at the same time.

What It Says

"When the revolution comes, all of you mindless jerks are going to be the first against the wall."

Speed Bumps

Diesel models are slow enough to cause brain damage. Parts prices induce fainting. Oddly fashionable with hipsters, so supply is dwindling.

Why You Want It Anyway ...

Minor components will outlive your children's children. Later diesel versions produce little smoke and sip fuel like a hybrid. Apocalypse transportation par excellence.

Alternative

1979 to 1992 Peugeot 505: Modern reliability plus French ride comfort equals wonderful.

Price Range

\$1500 to \$10,000



Mercedes-Benz E-Class

1986 to 1995



PM
TANKS

Volvo 240 Sedan

1982 to 1993

Why It's Cool

Stodgy, but charmingly so. Dana rear axle will hold up to a V8 transplant. Legendary safety; could fall off the Chrysler Building without denting a bumper. Eats road trips whole.

What It Says

"I don't believe in aerodynamics, I just believe in me. And these Birkenstocks."

Speed Bumps

Faster than the Mercedes, but not by much. Suspension rubber is notoriously short-lived. Available with an 82-hp, Volkswagen-built diesel six, which is neither powerful nor efficient.

Why You Want It Anyway ...

You like driving into things and

surviving. You like carrying things while driving into things and surviving. You have a spare Chevy 305 in your backyard and need a place to put it.

Alternative

1982 to 1988 BMW 535i: ubiquitous and boxy, like the Volvo, but fun to drive. **PM**



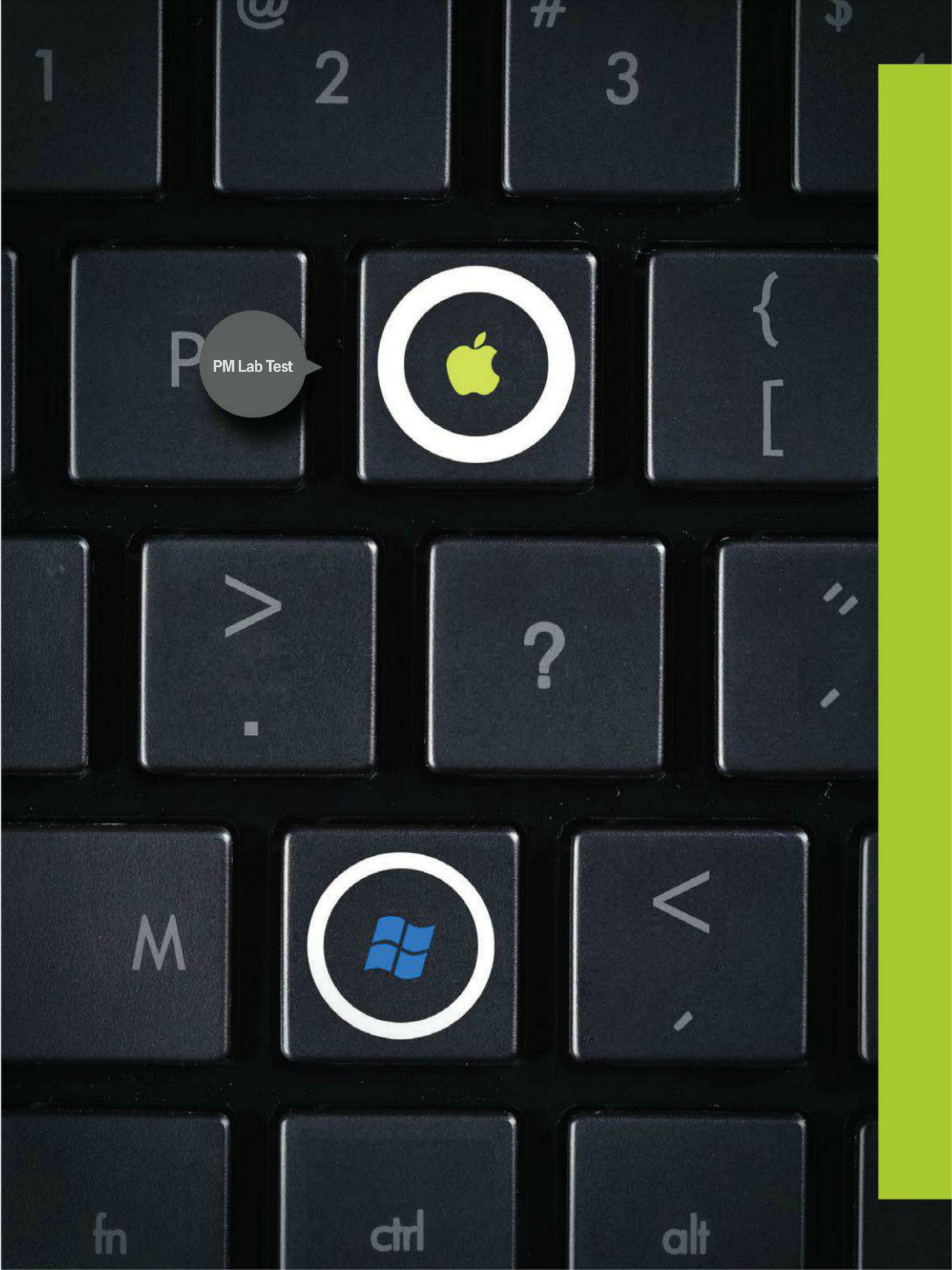
Price Range

\$1500 to \$6000



DO YOU NOW HAVE USED-CAR FEVER? LEARN HOW TO INSPECT A PRE-OWNED MODEL AND PICK THE PERFECT CHARIOT.

PM
Used-Car
Checklist
p. 113



PM Lab Test

Mac

By John Herrman

The desktop operating system may soon be dead. Apple's latest release of OS X, Lion, shows a heavy influence from iOS, the operating system found on iPhones and iPads. Likewise, the upcoming Windows 8 OS, expected in 2012, is inspired by smartphones. Yet the personal computer itself is far from

PC

gone. Sales may be down, and tablets may be hot, but there are still more than 260 million laptops and desktops that serve as the primary window through which Americans work and play. And many people feel their computer choices define them—allegiance to an OS can be as passionate as loyalty to a sports team or a political party. Well, it's time to stop the bickering and cut through the rhetoric and marketing once and for all. We purchased two near-identically spec'd laptops, one

with Windows 7 and another with Mac OS X Lion, and subjected them to a brutal battery of tests to see which UI has the higher IQ.

Photographs by Devon Jarvis

The Contenders

\$1200



Model: Apple MacBook Pro

Processor: Intel Core i5, 2.3 GHz
Graphics: Intel HD 3000
RAM: 4 GB DDR3
Hard drive: 320 GB, 5400 rpm
Screen: 13 inches, 1280 x 800 pixels
Battery life: 7 hours
Ports: 2x USB, Ethernet, Thunderbolt, FireWire, SD
Operating system: Mac OS 10.7 Lion

Model: HP Pavilion DM4

Processor: Intel Core i5, 2.3 GHz
Graphics: Intel HD 3000
RAM: 4 GB DDR3
Hard drive: 500 GB, 5400 rpm
Screen: 14 inches, 1366 x 768 pixels
Battery life: 6.75 hours
Ports: 3x USB, Ethernet, HDMI, VGA, SD
Operating system: Microsoft Windows 7, Service Pack 1

\$750



Our Test Results

Mac	PC
Processor Speed Score	
6429	6524
Graphics Speed Test (fps)	
12.64	9.7
Gaming (fps)	
31.6	32.8
Six-App Simultaneous Launch (sec)	
10.5	11.5
Video Conversion (sec)	
196	220
YouTube HD CPU Usage	
59%	5%
File Compression (sec)	
19	95
Wake From Sleep (sec)	
4.48	5.12

Yellow indicates winner

HOW WE TESTED

Processor tests were conducted with benchmark software Geekbench 2.1.13, which assigned each machine a performance score. The Cinebench 11.5 benchmark was used to test raw

graphics capability in frames per second (fps). Our gaming test relied on Valve's Portal 2 run at high-quality settings. For video conversion, we used HandBrake 0.9.5 to convert a 720p H.264

video to a mobile size. App-launch stress testing used Microsoft Office (Word and Excel), Adobe Photoshop, Mozilla Firefox, Google Chrome and HandBrake. We played a YouTube HD video to

see how severely Flash video strained each system's processor. For the compression test, we compressed 786 megabytes of files using the operating systems' built-in archive functions.

User Experience

We gave our machines to everyday users. Here's what they thought.

Business Traveler

"The Mac's navigation is cleaner and more organized. However, it doesn't automatically maximize apps, which adds an extra step. I prefer the PC's separate left/right click buttons, and without guidance I never would have known about OS X's finger gestures. Both machines, however, would suit my needs."

Teacher

"The PC has a bigger screen at the same weight. Navigation in both OSs is easy if you know what to do, but neither is intuitive. Aero Peek in Windows is great, as are Jump List shortcuts in the Start menu. I've been a Mac user forever, but I think I'll switch to a PC for my next computer."

Know Your Interface



Mac: The first version of OS X (10.0), called Cheetah, launched a decade ago, and much of it remains in Mac OS X Lion (10.7), including the **Dock**, an applications launcher. But there have been significant changes. **Mission Control** provides a bird's-eye view of the OS, where users can see and organize open applications and switch between separate desktops, or Spaces. Other features have been carried over from smartphones: Apps are downloaded from the App Store, and programs are suspended rather than fully closed, so that saving files isn't necessary. Smartphone and tablet users will easily grasp the new multitouch gestures, but it can be hard to tell where the "home" of the OS is. Is it Mission Control? The Dock? The iOS-style Launchpad?



PC: Windows' greatest strength is familiarity. Its core navigation and application-launching tools, the **Start menu and taskbar**, were introduced in Windows 95; these features, along with much of the logic of the menus and keyboard shortcuts, have changed little since, meaning that anyone who has used Windows in the past 15 years will feel at home in Windows 7. Yet Microsoft has done much to improve the Start menu/taskbar concept over the years, adding instant menu and file searching, visual application previews and a view called **Aero Peek**, which lets users find windows by hovering the cursor over the taskbar.

Where some users will find comfort and consistency, others will find staleness. Windows 7 is a refinement, not a reimagining.



Animator

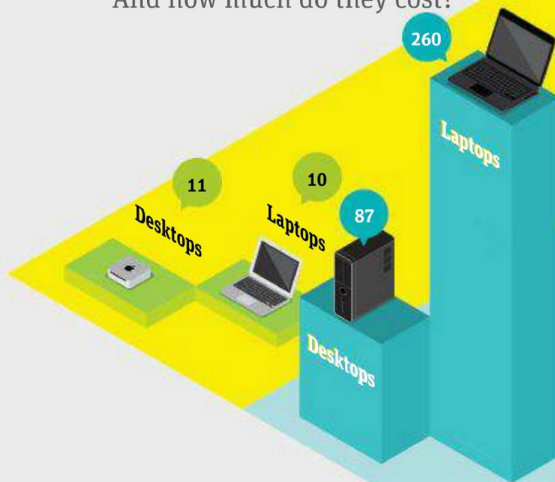
"Windows feels clunky—it reminds me of my old computer, but at least I know where stuff is. Mac hardware and software feel more modern, but I don't see the point of some of the gestures."

Gamer

"Both Web browsers are terrible—download a new one. Seems like there's more to set up with a PC. The HP's hardware feels cheaper, but I like the roundness and slick feeling; the Mac finish is gritty, and edges are sharp. Both are fine for multimedia, but for gaming, PC wins."

Hardware

How do buyers' options stack up?
How many models are there?
And how much do they cost?



Mac: Apple's hardware is attractively designed and well-built, but options are limited and expensive. Macs also have certain hardware limitations: no Blu-ray drives, no HDMI ports in laptops and no removable batteries. Many laptops have flash storage, which is fast but limited in capacity.

MAC STARTING PRICE

Laptop: \$1000
Desktop: \$600

PC: Microsoft lets anyone make Windows PCs, which means there are plenty of options in specifications, designs and prices. A vast array of ports and accessories is available. Hardware quality runs the gamut from topnotch to poor; hardware prices, from sky-high to bargain-basement.

PC STARTING PRICE

Laptop: \$250
Desktop: \$200

Software**What's Included**

Mac: OS X Lion comes with a suite of apps, including iTunes (music), iPhoto (photo management), iMovie (movie editing), Mail and Safari (Web browser). Serious document-editing apps are not included.

PC: Windows 7 comes with few apps, but Microsoft offers many of the missing pieces, including email, movie editing and photo management, as free downloads. PC makers often bundle Microsoft Office for free, but also include unwanted bloatware.

What's Available

Mac: Today's most popular apps are available on the Mac OS—where there is no Mac version of a Windows app, there is often a quality alternative. Gamers, however, will find little comfort in Mac OS's anemic game selection.

PC: Windows has a glut of available software, and no central app store. You may always be able to find the app you need, but it may take some work. Thousands of games, from vintage to cutting-edge, are available.

Platform Agnostic

No matter which side you're on, you'll end up using a lot of the same apps. Here are some of the must-haves.

Firefox/Chrome: Fast, full-featured Web browsers that are better than either Safari or Internet Explorer.

Microsoft Office/OpenOffice: Office is the de facto productivity suite; OpenOffice is a capable free and open-source alternative.

Dropbox: An online storage locker for your files. Drag and drop files the way you would with a flash drive.

Google Apps: Websites that behave like apps, including Gmail, Google Docs and Google Calendar.

Facebook and Twitter: The most popular social sites don't have a stake in the Mac-versus-PC battle.

LAST WORDS

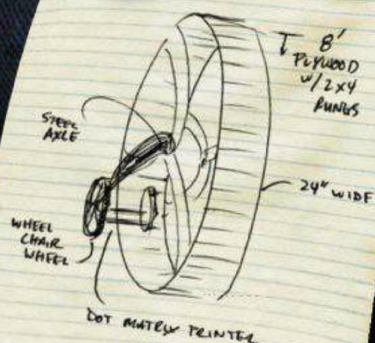
The battle between platforms is over. In our tests, raw performance was almost identical. Support for third-party software was close to equivalent. While our Mac felt faster by a hair, our PC was cheaper by a mile. Our PC came with a bundle of free software, but our Mac was impervious to viruses. The point is, as tools, these machines are both hugely—and equally—capable. And make no mistake: In 2011, tools are what they are. Smartphones and tablets have stolen our attention and affection away

from laptops and desktops, and they're not giving them back. Besides, Google, Facebook, Twitter and Bing, where we spend so much of our time, are apolitical. So, if you love Macs, stay put. Likewise for PC partisans—Apple's touch-inspired software and sleek hardware are neat, not essential. For everyone else, the choice is simple: Save your money and buy a PC. It'll get the job done. And if you're interested in the real future of computing, take that extra cash and pick up an iPad. **PM**

72

HOURS TO TURN

THIS



INTO THIS

TEAM: 1.21 JIGAWATTS

Minneapolis

Team Members: David Heisserer, Dillon Hodapp (in wheel), Cory Huseby, Nathan Knutson

Creation: Hamster-wheel dot-matrix printer

These *Back to the Future* fans built the winning creation: a human-size, plywood exercise wheel outfitted with a dot-matrix-style printer constructed from seven servo-controlled spray-paint cans. The printer was fitted with a cellphone antenna and SIM card, and audience members at the competition were encouraged to text words to the printer. The result was a painted word-salad trail somewhere between poetry and vandalism.



On an insanely hot Sunday in July, 16 sweaty, exhausted teams from around the country rolled, pedaled, skated and cranked a collection of unusual machines across an asphalt field in Brooklyn, New York's McCarren Park. The teams were vying for the \$5000 grand prize in the first-ever Red Bull Creation event—an attempt to add a little competitive spirit to the nascent maker movement. They had been given three days to hammer, weld and wire together as much as 200 pounds of gear they brought with them with whatever they could salvage from a communal junk pile, as well as from the streets of New York City itself. On day one, the challenge was revealed: Construct a device capable of moving a 100-pound person without using fossil fuels. The results would be judged by a panel of professional technology junkies, including *POPULAR MECHANICS*' senior editor Glenn Derene.

What ensued was a down-to-the-wire drama of competition, imagination and a surprising amount of cooperation as the teams pursued the cash award and a state-of-the-art laser cutter for each winning team member. Most important, the winners got the ultimate in geek bragging rights—and the opportunity to bring forth order from chaos.



TEAM: INNOVATION THIRST

Greenville, Texas

Team Members: Justin Griggs, Chris Horne, Greg Needel (above, right), Jeff Waegelin

Creation: Play-Powered Pod

PM editor Glenn Derene (above, left) tried out a few swings on the team's moving playground, an ambitious attempt to turn swinging and seesawing into electricity. It didn't quite work as planned. "It was way more mechanically sophisticated than we should have tried in 72 hours, but we wanted to be the team to go for broke," says team member Greg Needel.

Those who survived three sleep-deprived days of MIG welding, sawing, computer programming and wiring then had to demonstrate their vehicles in front of a crowd on a baking-hot asphalt lot.



**TEAM:
i3DETROIT**

Ferdale, Mich.

Team Members:

Nathan Bezanson,
Ted Hansen (right),
Eric Merrill,
Roger Slykhouse

Creation:

Squiggle Trike

Inverting the Motor City's traditional fuel-exhaust relationship, i3 built a vehicle that uses compressed CO₂ to drive two lever-mounted, rotation-locked wheels from side to side, propelling the Squiggle Trike with a Rollerblade-like sweeping motion.



**TEAM:
TECHSHOP**

San Francisco

Team Members:

Sean Cusack, Danny
Garcia (right), Charlie
Nguyen (near right),
Carter Stokum

Creation: ICU Later

Winners of the team award, TechShop created a teeter-totter that lifts riders 12 feet in the air and spins 360 degrees. At the 2 g's rotational mark, Polaroid cameras snap riders' photos. After the competition, the team shipped the contraption back home, where they plan to add pyrotechnics.

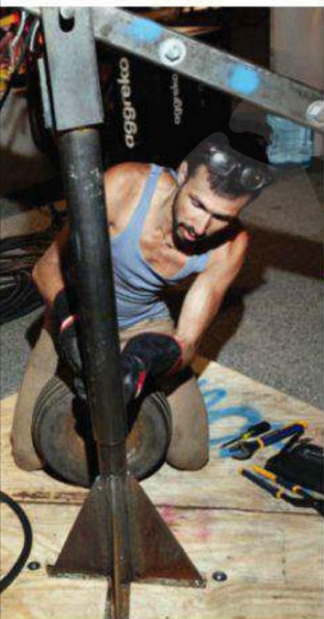


Some teams actually finished a few hours early, but Greg Needel of Innovation Thirst worked down to the wire, connecting the gearboxes before taking his hands off the team's project at the final second.



TEAM: EFFIN LADIES From "all over the effin' place"
Team Members: Sarah Kihls (above), Laura Leva, Zorah and Tirzah Rodgers **Creation:** Human-powered beverage cooler

The Effin Ladies' ambitions got the better of them. The team of four worked tirelessly to create a near-inexplicable combination of elevator and refrigerator, which, unfortunately for them, neither elevated nor refrigerated in the public showdown.



TEAM: DONNER PARTY 2.0 Truckee, Calif. **Team Members:** Grant Kaye, Justin Self, Randy Vasquez (on bike), Justin Winter **Creation:** Electric trike with blender/dryer trailer

Donner Party's custom three-wheeler had dual electric power systems with separate priorities. The trike was propelled by a lithium-ion electric-assist drive, but a second, 12-volt battery was hooked up to a blender hidden inside a salvaged, graffiti-covered dryer. The result was a legally dubious combination of vehicle and margarita machine. **PM**

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Vintage Audio in the Digital Age

DON'T DITCH THAT HI-FI! MARRY YOUR DIGITAL MUSIC COLLECTION WITH YOUR ANALOG AUDIO GEAR. BY MARK WILSON

➔ **There was a time when we shared music** through walls rather than social networks, when we prized the tactility of knobs and dials over the numb stroke of a thumb on a touchscreen. Electronics weren't disposable, and we understood that newer didn't always mean better.

The '70s were important years for the audio world, and they left a lasting legacy. Today, vintage audio

DIY

Tech



Speakers:
KLH Model 20
(1965)

**Digital media
streamer:**
Logitech
Squeezebox
Touch (2011)

Stereo receiver:
Sansui 7070
(1976)

INSIDE

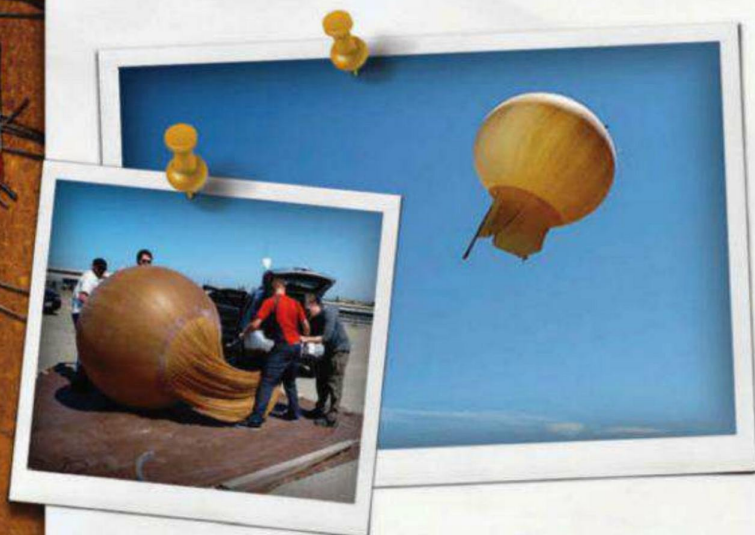


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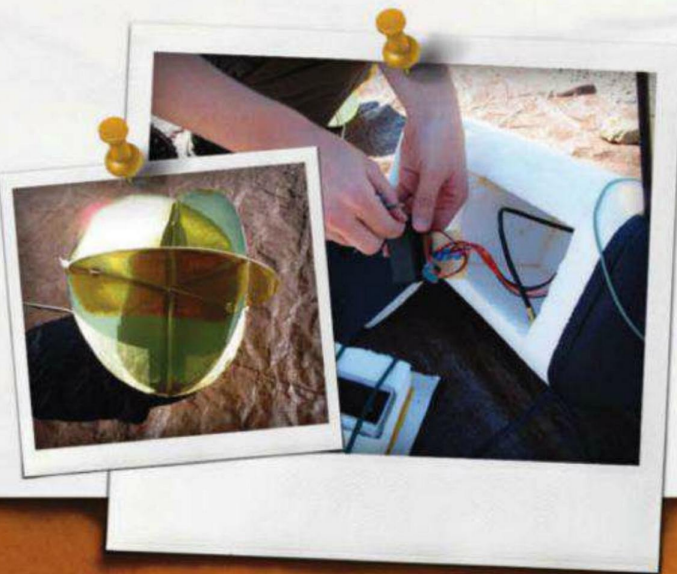
"Our experiments started with a cell phone and a camera," says Christopher Lincoln, a member of Spacebridge—a group of high-altitude enthusiasts based in San Francisco who use weather balloons and off-the-shelf electronics to explore regions of the atmosphere usually only seen by astronauts on their way to orbit. Since that first test flight, their tools have become more sophisticated, but, says Christopher, this is an activity that's accessible to just about anyone with sufficient curiosity: "It takes a little bit of skill and just a little money to get up there and start taking pictures from altitude."

Launching from the relatively uncrowded airspace of California's Central Valley, the Spacebridge crew has sent payloads up to 100,000 feet. This is only a third of the way to space, but the dramatic pictures taken from this height reveal a black sky and the curvature of the Earth below.

The helium-filled balloon expands as it ascends, finally bursting and letting the payload parachute back to Earth. This consists of a small styrofoam box containing a compact digital camera, a microcontroller and a cell phone. The microcontroller is a small computer that controls the camera, triggering it to take pictures at regular intervals, and the cell phone uses a simple tracking application normally used by parents to keep tabs on their teenagers; it "phones home" to let the crew know where it landed.

The Spacebridge team makes sure the payload is under the four-pound maximum allowed by the FAA (it's considered an amateur meteorological experiment). They attach some lights and radar reflectors, carefully predict the flight path and put out a call to all local airmen just before launch (in the Central Valley, these are mostly crop dusters, who are often curious about what they're up to).

In addition to perfecting their launch platform, the people of Spacebridge also have education in mind. Their goal is to make their experiments reproducible by students, teachers, parents and "anyone who wants to be hands-



on with their own education," says Christopher. They're working with teachers to create lesson plans, and they present at fairs and conferences to connect with anyone who might be interested. At one such event, a woman with her young daughter was having a long conversation with one of the Spacebridge team. Finally, the girl, who had been listening quietly, whispered to her mom, "Can we do this at home?"

Future plans for Spacebridge include the use of a transmitter for in-flight retrieval of images and data, as well as the launching of a model rocket from the balloon at its peak height to obtain an additional 30,000 feet!

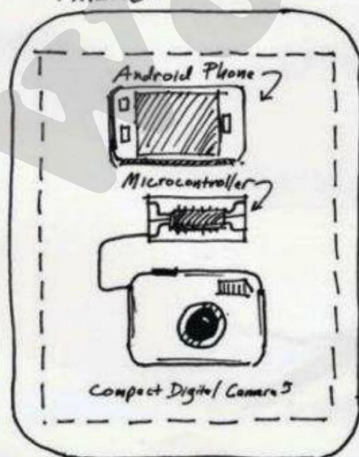
Find out more about what the Spacebridge folks are up to on their website: www.noisebridge.net/wiki/Spacebridge

By Ken Murphy

PARTS

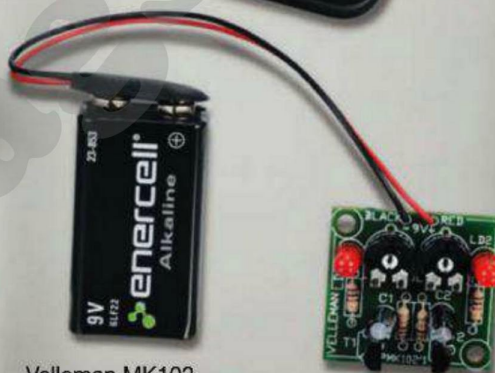
- ☐ 2300 Gram Weather Balloon (military surplus)
- ☐ Parachute
- ☐ Styrofoam (aka polystyrene foam) insulation (used to construct payload box)
- ☐ Velleman MK102 Flashing LEDs kit: 277-030 (used as safety lights)
- ☐ Android Phone (for tracking and recovery)
- ☐ Compact Digital Camera (modified to connect to microcontroller)
- ☐ Microcontroller (for controlling camera)

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Android Phone



Velleman MK102
Flashing LEDs Kit



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DIY

Tech VINTAGE AUDIO GEAR

equipment is anything but rare. Aging speakers and receivers fill basements across the country, or sit decoratively and underutilized in living room corners. They're fixtures at garage sales and thrift shops, yet they are also the rare type of tech product that gets passed from generation to generation.

This isn't just about nostalgia—vintage audio equipment simply ages well. Many older receivers and speakers still produce remarkable sound—often better than the overamplified, under-tuned, all-in-one 5.1 surround-sound systems that have come to dominate the home audio aisle—and they're certainly more attractive than some of their modern counterparts.

One problem: Our music collections are increasingly digital—iTunes downloads, MP3s and streaming services—while vintage audio equipment is decidedly, and even proudly, analog. Here's how to bridge the gap, bringing your classic audio equipment into the Internet age.

The Good Old Gear

➔ **In terms of stereo equipment,** the late '60s and the 1970s were a golden age. As Japan's tech giants lusted after the American hardware market, companies such as Kenwood, Pioneer, Yamaha and Sansui overbuilt and underpriced their receivers to get a piece of the action. This is a boon to music lovers today, as it was 40 years ago: If you don't happen to have a pile of audio equipment in storage already, acquiring some is appealingly cheap.

"Those things are phenomenal," says *Stereophile* senior contributing editor Michael Fremer. "They sound so good, and you can pick one up for \$20 or \$30." Pitted against today's home audio gear, a classic Kenwood receiver, for example, fares remarkably well, driving a full, powerful and variously adjustable sound.

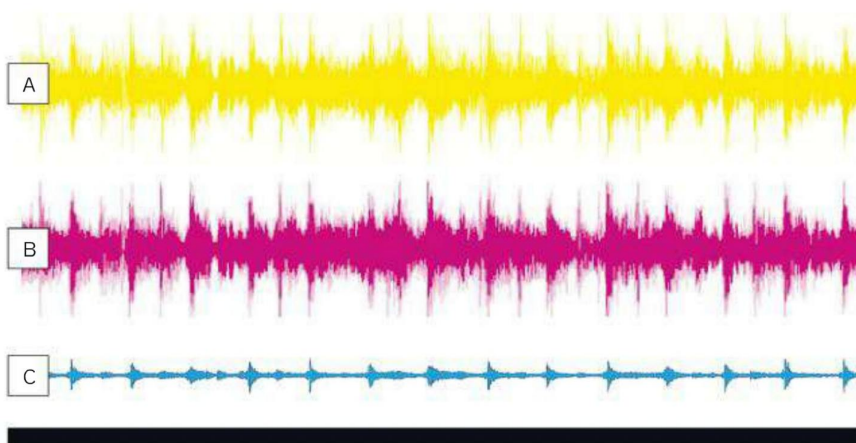
And then there's the design. Vintage audio equipment often looks as beautiful as it sounds; certainly more appealing than the plain plastic and sheet



A LOSSLESS AUDIO
The first image represents 10 seconds of Elvis Costello's "You Belong to Me," recorded in FLAC lossless audio format, which audiophiles swear by. The file is completely faithful to the source material, but it takes up 25.6 MB of space.

B TYPICAL MP3
The second image represents the same 10 seconds compressed into MP3 format at a quality of 192 kilobits per second—about what you get from a service such as iTunes. Sound quality is acceptable, and the song takes up just 3.5 MB of space.

C THE DIFFERENCE
To create the third clip, we've subtracted the MP3's sound data from the lossless file's sound data (directions at jax184.com). The resulting clip is a full representation of what audio was lost to compression. Played back on its own, it sounds hollow and distant but still like the song.



metal aesthetic adopted by so many modern electronics manufacturers. Stained wood, brushed aluminum and glass are par for the course in '60s- and '70s-era gear. Control panels glow in soft orange, blue and green hues, and needles bounce with the music. It's a distinctly high-end look, available for a bargain-basement price, if not for free—thanks, Dad!

The Way of the Wire

➔ **Getting this older gear** to play your modern music isn't as hard as you might imagine. The simplest way to bridge the digital-to-analog gap is the commonplace analog connection standard that was popularized in the 1950s—the humble RCA plug. Stereo RCA cables are identified by their red and white connectors, but the basic RCA plug format, with its rounded post and stamped metal sheath, is also the interface for everything from phonograph connections to modern component video.

Since RCA has been a standard for more than half a century, virtually every digital plug manifestation has been forced to play nicely with it, so you can buy adapter cables to bridge a 3.5-mm mini headphone jack to RCA for \$5 or less at nearly any electronics store. Technically, this is an analog-to-analog connection, so it's virtually foolproof.

If your music source doesn't have a spare 3.5-mm jack, there are adapter options for most common plug types. Online retailers such as Monoprice carry affordable adapters that convert Apple's 30-pin port to RCA (for iPods, iPhones and iPads), USB to RCA digital-to-analog converters (for computers) and mini/micro USB to RCA

converters (for Android phones and tablets), which will let you plug your digital audio devices into any receiver.

If you're willing to invest a bit more for a higher-quality link between your computer and receiver, a dedicated digital-to-analog converter can bypass your computer's soundcard to produce a cleaner source audio signal. The low-end soundcards included in many computers, especially laptops, are prone to interference and noise. Digital-to-analog converters skip over your PC's sound processor by receiving a raw digital audio signal over USB. Products such as the HRT Music Streamer II (\$150) or NuForce Icon uDAC-2 (\$130) are good bets.

Over the Air

➔ **Plugging your digital source** directly into your receiver is simple and cheap, but it's useless if your receiver is far from your music source. There are several wireless technologies that can act as a bridge between, say, a desktop in an office and the receiver in the living room. Wireless interfaces also make it easier to control your music—you can keep your iPod or smartphone in your pocket and play party DJ from any room in the house.

Assuming that you use a lot of Apple iOS devices, the AirPlay standard is likely your best bet. An Apple AirPort Express or AppleTV can serve as a wireless digital-to-analog converter, receiving a Wi-Fi stream of music directly from your device—be it an iPhone or a laptop—and sending it to your receiver via a 3.5-mm jack. (This will require the aforementioned 3.5-mm-to-RCA adapter.)

You can also send your music from your computer to your iPod, iPad or iPhone by using a clever program called Airfoil (\$25, PC and Mac). This turns your iDevice into the audio interface, while you stream from the endless catalog of music on your main machine.

If you have a catalog of tracks on a Windows PC, you can also stream music through a Windows Media Extender with analog output capability, the most popular of which, by a long shot, is the Xbox 360. You can stream to an Xbox from a Mac too, but it will require some third-party software such as Nullriver's Connect360 (\$20).

Neither the AirPort Express nor the Xbox 360, however, is specifically an audio device. The AirPort is a wireless hotspot first, and a music streamer second; likewise, the Xbox 360 is a \$200 game console that just happens to be an excellent music device. If your only goal is to stream music from a computer to a stereo system, and particularly if you would like to connect your digital music collection to *multiple* receivers, the simplest option is an ingenious little product called the Orb MP-1 (\$80).

This 3.3-inch discus-like device serves one purpose: to receive audio via Wi-Fi, and to pass it along to a 3.5-mm audio jack. It's small enough to hide behind a receiver or speaker, and cheap enough that a house-wide deployment—one for the system in the living room, one for the kitchen and one for the bathroom—won't break the bank. The Orb comes with software that makes sending tunes from one side of the house to the other as simple as clicking on an icon in the free Orb Caster desktop app (PC or Mac), or using one of the accompanying smartphone apps, available for both iOS and Android.

But none of these solutions will impress true audiophiles, since none of them support FLAC, the de facto uncompressed digital audio format. FLAC offers greater clarity and quality than most MP3s and downloaded music, and if you've amassed a digital collection of lossless music that you'd like to wirelessly connect to your stereo system, you'll need a streaming device that supports it. The Logitech Squeezebox Touch (\$280) isn't cheap, but it builds a sturdy wireless bridge between your FLAC library and your receiver, and includes support for Internet radio, as well as streaming music services such as Spotify, Pandora and Rhapsody.

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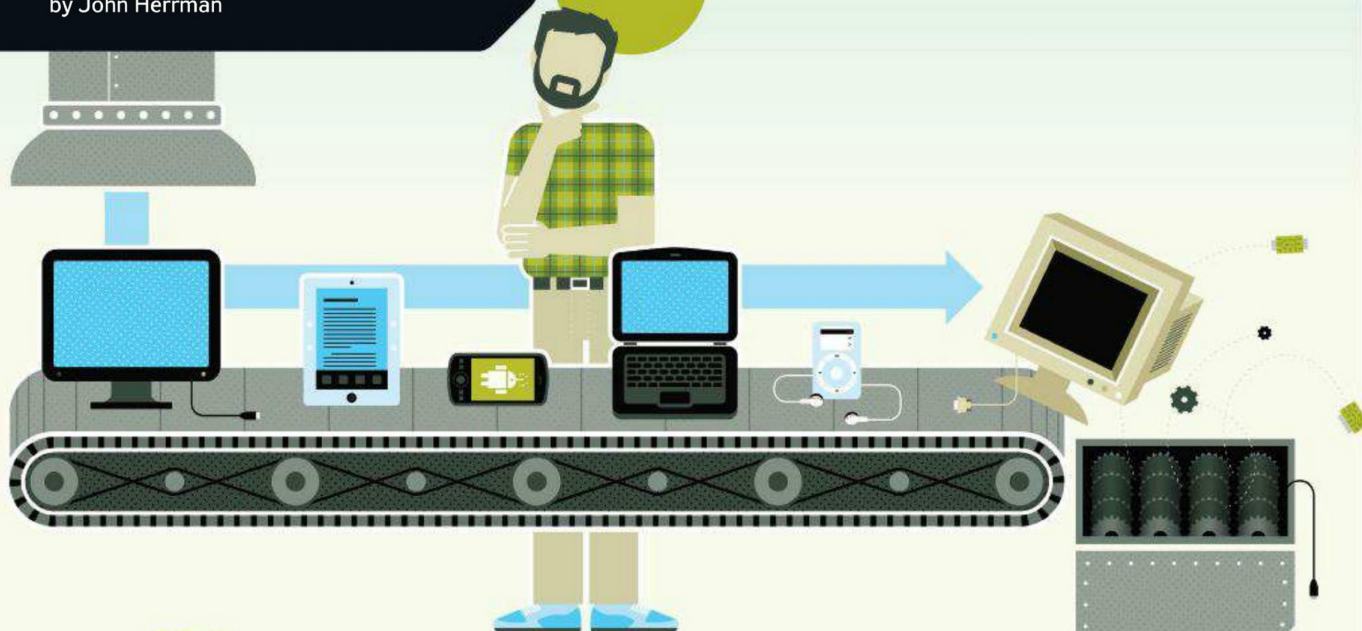
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Digital Clinic

by John Herrman

Q+A



Q

Ending the Gadget Guessing Game

I was thrilled with my new laptop—until a better model hit stores two weeks after I got it. How can I avoid this kind of buyer's remorse?

A Of the countless tech-related questions I get from friends and family, one towers above all others: "When is the next iPhone coming out?" My answer is always the same: "I don't know. But I have a pretty good guess!"

At the heart of this question is a fear shared by all would-be gadget buyers: that something better is just around the corner, so buying now would be foolish. But if not now, when?

There is a small but fertile online industry dedicated to answering precisely this question, and the sites that algorithmically answer your when-to-buy queries work quite well. *Retrevo* (retrevo.com) monitors activity at online retailers, news wires and review sites to compile a dossier on virtually every gadget in the world, including comparative price information, reviews and—crucially—a chart showing how far along a gadget is in its life cycle: "new," "reaching its prime," "over the hill" or "ready to retire."

Decide (decide.com), a newer product-tracking engine, gives more forceful advice, issuing a "buy" or "wait" recommendation and laying out products' full release histories. (At the time of writing, *Decide* indexes only laptops, televisions and cameras; the company says additional categories will be added soon.)

Anyone with questions specifically about Apple's products can refer to the venerable *MacRumors Buyer's Guide* (buyersguide.macrumors.com), which has been issuing clear and dependable when-to-buy advice for Apple gear since February 2003. "Some people enjoy reading the rumors," says founder Arn Kim, "but the biggest

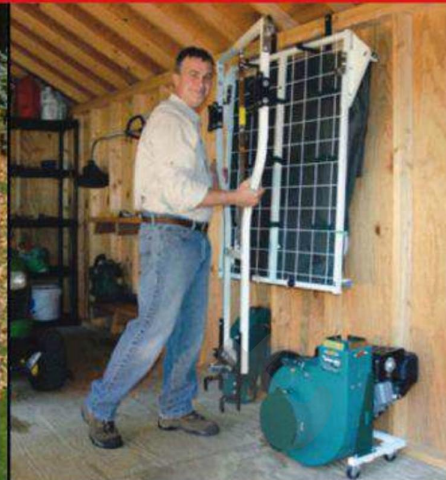
reason to visit a site like ours is to get help making a buying decision."

If these sites don't settle your nerves, you can fall back on a few rules of thumb. Smartphones, tablets, cameras and televisions—most electronics, actually—are typically refreshed or replaced on a yearly schedule. Check the manufacturer's website to see if your desired gadget has been on the market for more than nine months, and adjust your plans accordingly.

Laptops and desktop PCs are trickier. Intel, which makes the processors in most of the computers on the market today, follows what it calls a tick-tock upgrade cycle. Every other

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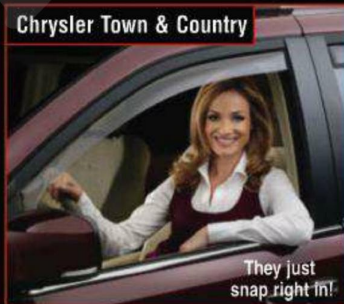
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Tech DIGITAL CLINIC Q+A

year the company revamps the way it makes its chips so that its factories can squeeze more processors out of a given quantity of silicon (this is known as a die shrink, and results in lower prices and leaps in processor efficiency); the last time this happened was early 2010. In between these updates are smaller changes to the chips, called microarchitecture updates.

Buying at the beginning of the “tick”—the die-shrink phase—practically guarantees against buyer’s remorse, but waiting a full year is often not an option. Computers with processors younger than nine months are a safe bet.

Lastly, beware of the sale trap. Unusually low prices may be a sign that a retailer knows something you don’t and needs to clear its inventory to make way for an imminent replacement. Nothing ruins a great deal like instant obsolescence.

The Accidental App Buyer ➔ **My toddler son, tech prodigy that he is, managed to buy a rather expensive app on my smartphone. Is there any way I can get my money back?**

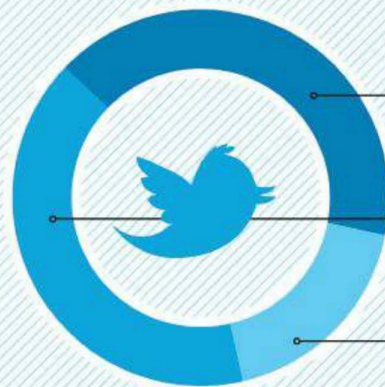
Some smartphones require a password every time an app is purchased. Others don’t—or permit a one-click purchase in a short window after the system password is entered. In any case, it’s easy to accidentally buy an app yourself—or for a curious youngster to do serious damage to your wallet.

You have some recourse here, but nothing is guaranteed. If you use an iPhone, you can appeal your purchase. Find the necessary form by following a link in the electronic receipt iTunes sends to your email. Just click Report a Problem at the bottom of the receipt. You’ll be taken to a website with a complaint form and a drop-down menu. Select “I inadvertently purchased this application” from the menu and describe the circumstances in the comment box. There’s no certainty that you’ll get your



SOCIAL FRAUD

ARE YOUR TWITTER FOLLOWERS REAL?



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How bad is Twitter’s spam problem? We decided to find out. PM intern Douglas Main hand-checked a thousand Twitter followers—500 of his own (@douglas_main) and 500 from PM assistant tech editor John Herrman (@jwherrman)—for authenticity. By his count, just 41 percent of those accounts belonged to real humans, while 18 percent were run by companies or institutions. The rest? Junk accounts, automatically updated with advertisements, computer-generated text and links to spam websites.

money back, but Apple is known to be lenient toward those who go to the trouble of asking.

Android app refunds are either much easier or far trickier, depending on your situation. If you notice your mistake immediately—for example, your young child taps Buy just before you're able to snatch your phone from him—you can uninstall the app for a full refund. The catch? You've got 15 minutes to do it. (In the Android market, select Menu and then My Apps, tap on the app, and click Uninstall and Refund.)

If the 15-minute window has closed, you can sign in to your Google Checkout account from a computer and request an order cancellation using the online form. In this case, though, you're at the mercy of the app's seller. Good luck.

Starving Artists

Streaming music services such as Spotify and Rdio sound like great deals, but here's what I don't get: If you can listen to unlimited music for \$10 a month, how on earth do the musicians get paid?

All-you-can-listen music services do pay artists, albeit in an unusual way. Subscription and advertising revenue (after operating costs) is divvied up based on proportional popularity. If one artist accounts for 20 percent of total listens, for example, he gets 20 percent of the total royalties. (Or, rather, his label does. A separate contract determines how much of this is passed on to the artist.) It's fair, but it's too early to tell if these services will find enough paying users to represent a serious source of income for artists. In any case, you can stream with a clear conscience. **PM**

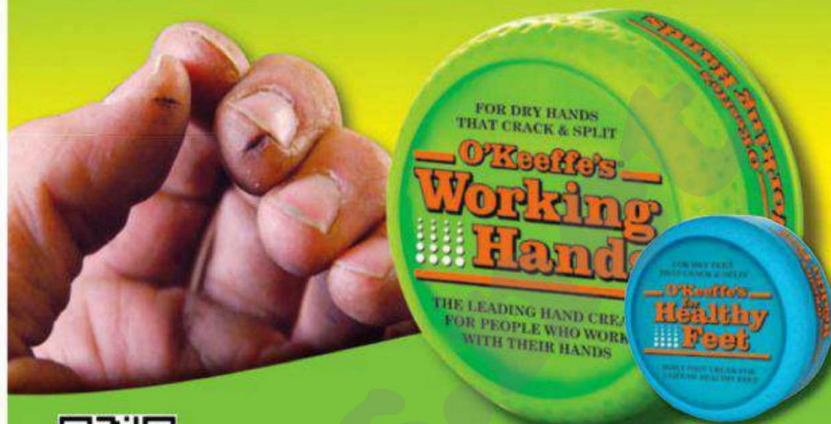
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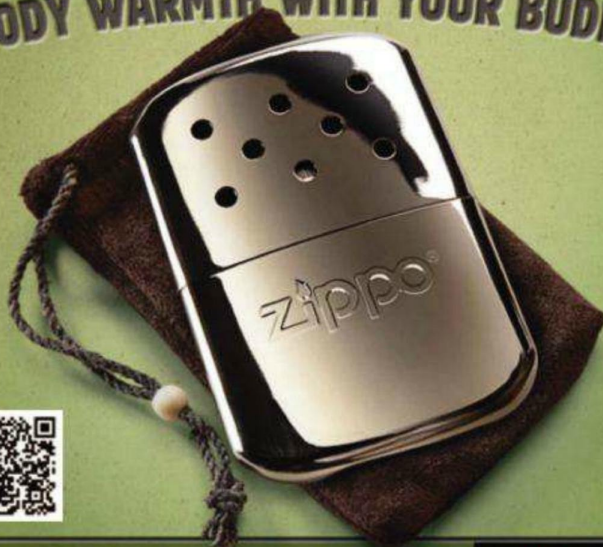
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Home



The Telltale House

WHETHER YOUR HOUSE IS HAUNTED BY POOR CONSTRUCTION OR SOMETHING SPOOKIER, GRAB A HAMMER. BY ROY BERENDSOHN

➔ **Every house has secrets.** Doors open or shut themselves. Lights flicker randomly. A toilet flushes on its own. And there's that deathly odor. You've been catching whiffs of it for years now, but you still can't seem to locate the source.

Sorry, but your house is creepy. Even if you don't believe in ghosts, the noises you hear in the dead of night still give you the heebie-jeebies. At the very least, you feel conflicted: You love your place, of course—but it really bothers you that it does stuff that you just can't explain.

Here at POPULAR MECHANICS, we call it SHS (spooky-house syndrome). Rich Robbins, associate dean of the College of Arts and Sciences at Bucknell University, in Lewisburg, Pa., is something of an expert on the subject. Each October his lecture "Ghosts and Hauntings: Decide for Yourself" draws a standing-room-only crowd. "We carry a prototype in our mind of what a house should be like," says

INSIDE



BATHROOM FIX-UP + LEAF-SACK RACK + FINDING HEAT LEAKS

DIY

Home TELLTALE HOUSE

Robbins, who holds a doctorate in social psychology. "When something out of the ordinary happens, we may or may not seek to explain it in rational terms."

Robbins says he's "agnostic" about ghosts; he's never seen one but can't disprove them, either. At PM, we're a bit more matter-of-fact. When things go bump in the night, we reach for our toolbox and get to work.

A GHASTLY STINK FROM THE SINK

You keep a tidy bathroom, so why does it smell as if a possum is buried beneath the vanity?

Possibility

An awful thing took place in there—think shower scene from *Psycho*—and an olfactory trace of the event remains.

More likely

The sink trap is dry. Normally it's filled with water, a simple and effective barrier to odors from the building's plumbing or the sewer system. But if the drain system has been badly designed or poorly installed, or the vent stack on the roof is plugged

with leaves and sticks, the result is the same: Draining water creates a vacuum and sucks the trap dry.

Another stink source may be the sink's overflow hole. The interior cavity leading from the overflow to the drain can become black with nasty-smelling slime.

The fix

Getting the drain to work properly may involve replumbing it and the vent system, but the remedy could also be as simple as clearing the vent stack with a length of wire or a plumber's snake. To make slime disappear from the overflow channel, flush it out with a cleaner that contains bleach or a mildew killer.

Burned neutral wire caused by looseness and an improper, counterclockwise wrap

WHO SHUT OFF THE LIGHTS?

Bulbs flicker menacingly. An electrical short crackles. There's a persistent but vague smell of burning plastic. Then—gulp—everything goes dark.

POSSIBILITY: After William Shatner plugged it with a revolver, the carpet-covered monster from the famous *Twilight Zone* episode dropped off the plane's wing and landed in your basement, where the beast has been chewing on the wiring in your electrical panel.

MORE LIKELY: There are dozens of reasons why lights flicker, outlets go dead and circuit breakers trip—none of them good, some of them dangerous. A few of the common problems:

1
The fix: Use the right-size wire connector. Line up the stripped wire ends so they are parallel; twist on the connector, turning it clockwise. Give a gentle but firm tug on the splice to check that it's sound.

2
The house has aluminum wiring, which was commonly used in the 1970s—and is notorious for thermal expansion and loosening at splices, switches and outlets.

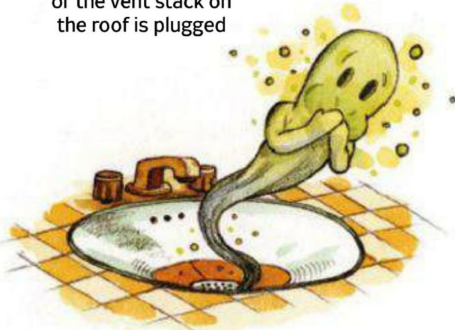
The fix: Have an electrician replace the wiring, or at least check all connections.

3
The light fixture is shot because someone "overlamped" it with a higher-wattage bulb than it's rated for. This overheats the fixture, its wiring and the splices that connect it to the house wiring.

The fix: Replace the fried fixture, and install a bulb with the proper wattage.

4
A loose connection lurks at a switch or an outlet.

The fix: Turn off the power, remove the wire from the device and cut away damage. Strip insulation and wrap the bare wire clockwise around the screw, then tighten firmly.



“My wife and I live in a home whose original construction dates to 1790, and I can't help imagining what's gone on there over the years. In cool weather, groaning and squeaking sounds emanate from the southwest corner of the house. The noises originate roughly from the area of the boiler and water heater, so I'm sure there's a mechanical explanation. But the sounds change pitch and cadence like a human voice, so it's unnerving. The house is talking!” — Joe Bargmann, *PM* special projects editor

Spooky, Self-Animating Doors

They slam shut on their own!

POSSIBILITY: The ghost of Aunt Mary, the one who hated drafts and always wore a sweater around the house, is letting her feelings be known.

MORE LIKELY: The door is hung out of plumb and fits so loosely in the jamb that the strike easily slips out of the

latch plate; gravity, not Aunt Mary's ghost, swings the door shut or open. A steady wind could also be to blame; it creates low pressure on the downwind side of the house, causing air to flow out. Any open door on this side of the house could swing shut due to the air-pressure differential. The problem may be

amplified by an open garage door on the downwind side. Intense low-pressure vortices form around the door opening.

THE FIX: A couple of hammer taps can put just enough bend in the hinge pin to increase friction and stop the door from swinging freely. Closing the garage on a breezy day can help, as can sealing air leaks with weatherstripping.

A low-pressure zone on the downwind side of the house can create enough suction to cause an interior door to slam.



“My parents’ house has mysterious and often inaccessible old places no longer needed in this life, where you imagine something still exists: a root cellar, an awkward attic, a dark area under the front porch where a toad or two lives comfortably in the summer . . . There’s also a closet door that has been stuck shut for decades. Once, in the bathroom someone happened to look up at a light fixture and saw something moving. It turned out to be a snake.” — Robin Tribble, PM copy chief



THEY'RE HEEERE!

But who are they? Phantoms, ghouls or spooks in the attic? Or maybe mice, bats or rats? (Scary either way, right?)

Sound: Scratching and scurrying at night

Source: Mice or rats

The fix: Place snap traps perpendicular to the wall, not parallel to it. Clear brush and shrubs next to the house. Clean the garage and keep all garbage cans tidy. Store pet food and birdseed in tightly sealed, gnaw-proof containers. Remove or bury dog waste.

Sound: Squeaking, twittering and fluttering at dusk or at night, and again at or just before dawn

Source: Bats

The fix: Consult a

pest-removal professional to clean up bat droppings, and place one-way bat-exclusion devices. Once bats leave, they cannot re-enter. Close up openings in siding and trim; screen off vents.

Sound: Scurrying during the day, usually in the attic

Source: Squirrels

The fix: Removal by an animal-control company. Look for large, gnawed entry holes and repair them. Use heavy screens on attic vents. Trim tree branches to prevent entry from the roof and eaves.

Sound: Heavy thumping, shuffling, gnawing and chattering at night

Source: Raccoons

The fix: Removal (usually of a nesting female with her young) by a pest-control professional. Trim tree branches or remove trees close to the house; likewise, clear shaggy shrubbery nearby. Repair flashing or vents that a raccoon may have torn away. Keep garbage cans clean; consider galvanized steel ones instead of plastic, or place cans in an enclosure reinforced with sheet steel.

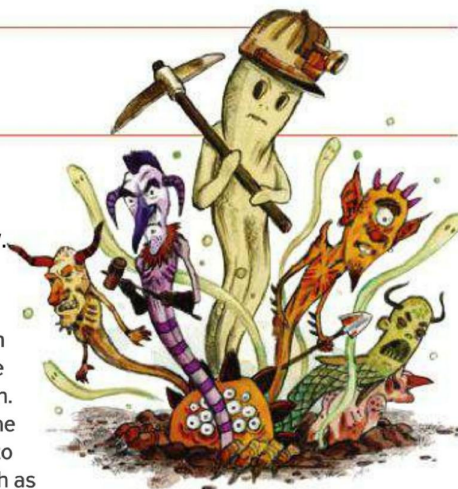
Mysterious Holes in the Ground

Tiny tunnel openings appear in your yard—and there's no sign of animal activity.

Possibility: Those holes are portals to the underworld, don't you know? Mischievous excavators use them to come and go when you're not paying attention.

More likely: You've got a collapsed foundation drain, or the concrete inspection cover on the septic tank has deteriorated and caved in. You may also have a sunken leachfield pipe (known as a galley). Sinkholes are also caused by oil tanks or cesspools that have caved in.

The fix: To find a damaged foundation drain, dig next to your house. Once you uncover the damaged drain, you can repair it. Yes, it's a big job. If you find larger damage, you'll need to hire an excavation contractor. Investigating larger collapsed underground structures, such as cesspools and oil tanks, is best left to the pros.



SQUEAKY-FLOOR FIXERS



DEAD TREES TALKING

Your house sounds like a horror movie. You can't go anywhere without a creaking noise emanating from a floor.

POSSIBILITY: The trees that became your house's framing have come back to haunt you, seeking revenge for the chain saw massacre that felled them. (And if you think trees can't be scary, try watching *The Wizard of Oz*.)

MORE LIKELY: Hardwood and carpeted floors squeak when the subfloor below flexes down against the floor joist.

THE FIX: The Squeeeeeek No More kit (above) fastens the loose subfloor to the

joist. Its floor fixture (A) positions and snaps off screws driven through hardwood floors. The screws (B) have a square drivehead and a scored shank to help them break off cleanly below the floor's surface. The alignment tool (C) assists in driving screws into carpeted floors; a notch in its side helps you grab the screw head and cleanly snap it and part of the shank below the surface of the subfloor. The specialty drive bit (D) has a stop collar formed in its shank; it's used with both the hardwood-floor fixture and the alignment tool for carpeted floors. Two square-drive joist-finding bits (E) are included with every kit. Drive one at each end of a joist to form a sightline to help you keep the screws on track as you work down the length of the joist.

ATTACK OF THE EVIL HEAD SLAMMER

Toilets flush by themselves, and there's this awful hammering sound when you use a faucet or the washing machine.

water to trickle out of the toilet tank. Eventually this trips the fill mechanism. The banging results from water slamming into a closed faucet. It also happens when flowing water is stopped by a solenoid valve in a washing machine or dishwasher. The sound reverberates through wall and ceiling cavities.

Possibility

A prankster elf makes its way through that loose basement window you've been meaning to fix, slams the toilet lever, then slips out, but only after banging its head on a cold-water pipe.

More likely

The mystery flush is caused by a worn-out flapper valve that allows

The fix

To correct the problem, replace the flapper. The pipe banging, known as water hammer, can be remedied by a cushioning device called a water hammer arrestor. For clothes washers, you can thread it onto the valve behind the appliance. In other cases, you have to cut the copper tubing and solder the arrestor into place. **PM**

To swap a flapper valve, shut off water to the tank and flush. Drain the remaining water, unclip or cut off the old flapper, and replace.



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Homeowners Clinic

by Roy Berendsohn

Q+A



Big Ideas for Small Baths

We have two bathrooms in our house, and I want to fix up the smaller one. We use it infrequently, but I still want it to look nice. I think the first thing that needs to be changed is the wall sink, which is original to the house and almost 30 years old. The tub is also original, but we changed the toilet about 10 years ago. Can you do an article on how to swap a wall sink, or at least provide us some tips?

A The wall sink (or vanity) sets the stage in a small bathroom. It's the first thing you see as you step through the door, and because the room is small, the sink assumes outsize importance in the room's function and aesthetics alike. It also can take quite a beating, so it's not unusual to see the sink chipped, stained or scratched. I think you're making the right move. Swapping it will transform the room.

In terms of difficulty, on a scale of one to 10, I'd rate the swap at about a five if the new sink and old sink are similar, if they take a nearly identical mounting bracket or hanger, and if the surrounding surface is drywall. That five can easily increase to a six or seven if the new sink is larger or shaped differently than the original or if it requires an unusual mounting bracket. Worst case, the seven increases to an eight or nine if the wall is tiled and you learn that the old sink was barely hanging on the wall, in which case you could be looking at tile removal and the installation of a new piece of lumber in the wall on which to affix the hanger. At that point, you might seriously consider an all-out bathroom remodeling job.

Regardless, the first step is finding a sink that you like and, if possible, downloading its installation instructions from the manufacturer's website. If you can't find instructions for the model that you like, contact the manufacturer's customer service department and ask someone there to email you a PDF of the directions. With these in hand, you can make an educated decision about the job's difficulty.

In the "five" version of the job, you install a new mounting bracket per the manufacturer's instructions. On the sink, you mount the faucet and supply lines, tailpiece and pop-up assembly. Then hang the sink on the bracket. Down below, you connect the sink's tailpiece to the trap and connect the trap to the trap arm that comes out of the wall. Connect the supply lines to the faucet at

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Home HOMEOWNERS CLINIC Q+A

the shutoff valves. The “seven” or “eight” version of the job calls for all this plus tile removal, wall cutting, carpentry, careful measuring, trial mounting—a lot of mess and fuss. It’s not mechanically difficult, but it is time-consuming. Expect two to three full days of work to get the job done right.

The Garage Gap ➔ There’s a space that has formed where the edge of my garage floor meets the concrete driveway. Do I fill it in with concrete?

No. Definitely do not fill it in with concrete or any other hard and inflexible material. In most cases, the gap occurs because the asphalt-impregnated felt strip that was installed when the house was built has weathered away. The space into which the

strip fits is known as an isolation joint. It isolates the concrete driveway from the garage slab and allows them both to move independently of each other during thermal expansion and contraction, preventing damage from their edges grinding together.

You can leave the gap alone (it won’t harm anything) or press a foam backer rod into it and then apply a flexible sealant on top of the rod. Backer rod is like a giant piece of spaghetti made out of plastic foam. Choose a diameter that fits snugly into the opening and press it about ½ inch below the surface of the garage floor or driveway. Then buy a couple of tubes of sealant.

Remember to clean the concrete surface before applying the backer rod and sealant. This helps the sealant bond tenaciously to the concrete. Use a biodegradable cleaner like Simple Green and scrub the area with a deck brush on a pole. Rinse the area, then let it dry.

The Not-So-Great Escape

➔ Our home is slightly less than five years old, but some of the interior walls are cold to the touch in the winter. The front entry is particularly drafty. What can we do?

First, identify where heat is escaping. It can leak around poorly sealed doors and windows. Infrared energy that streams away from baseboard radiators or radiant tubing in the floor can pass directly through badly insulated walls, ceilings and floors. Then there are building components that are a thermal-loss trifecta: They are poor insulators, with a high mass and a large surface area relative to a cold surface. They conduct heat directly to outside

Got a home-maintenance or repair problem? Ask Roy about it.

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air or the ground. Poorly insulated concrete floor slabs are a prime example. They can be a powerful heat drain.

A new breed of contractor is springing up to address these problems. Known as building performance contractors, they specialize in improving how a structure uses energy. Their work starts with a thorough inspection to determine where heat or inside air is escaping. Then they make recommendations about how to improve the problem, or they do the remedial work themselves. Aside from making the house more comfortable and energy-efficient, their efforts may also yield improved durability of materials like drywall, sheathing and siding. If the house's cold surfaces and air leaks are causing condensation to form in wall cavities, for example, correcting the problem ensures the components will last for decades rather than degrade prematurely.

One of the more effective tools these specialists use is an infrared camera to gather images of the house from the inside and the outside to identify where temperature changes occur. Bright white and yellow areas indicate hot spots; purple and black show cold areas. A purple spot on an interior ceiling can highlight damp drywall caused by a roof leak, or a cold-air infiltration. (You can also rent thermal cameras from Web-based and local sources.)

Another tool these contractors use is a blower door, a door-mounted fan with pressure gauges mounted nearby. Installed in a temporary frame in place of the front door, it blows inside air to the outside. This depressurizes the house and helps the contractor analyze air leakage.

These tests are expensive, typically \$200 to \$400. Repairs, air sealing and improved insulation might run anywhere from \$200 to \$2000. That cost is paid back in lower heating and cooling bills, and the house will be less drafty. **PM**

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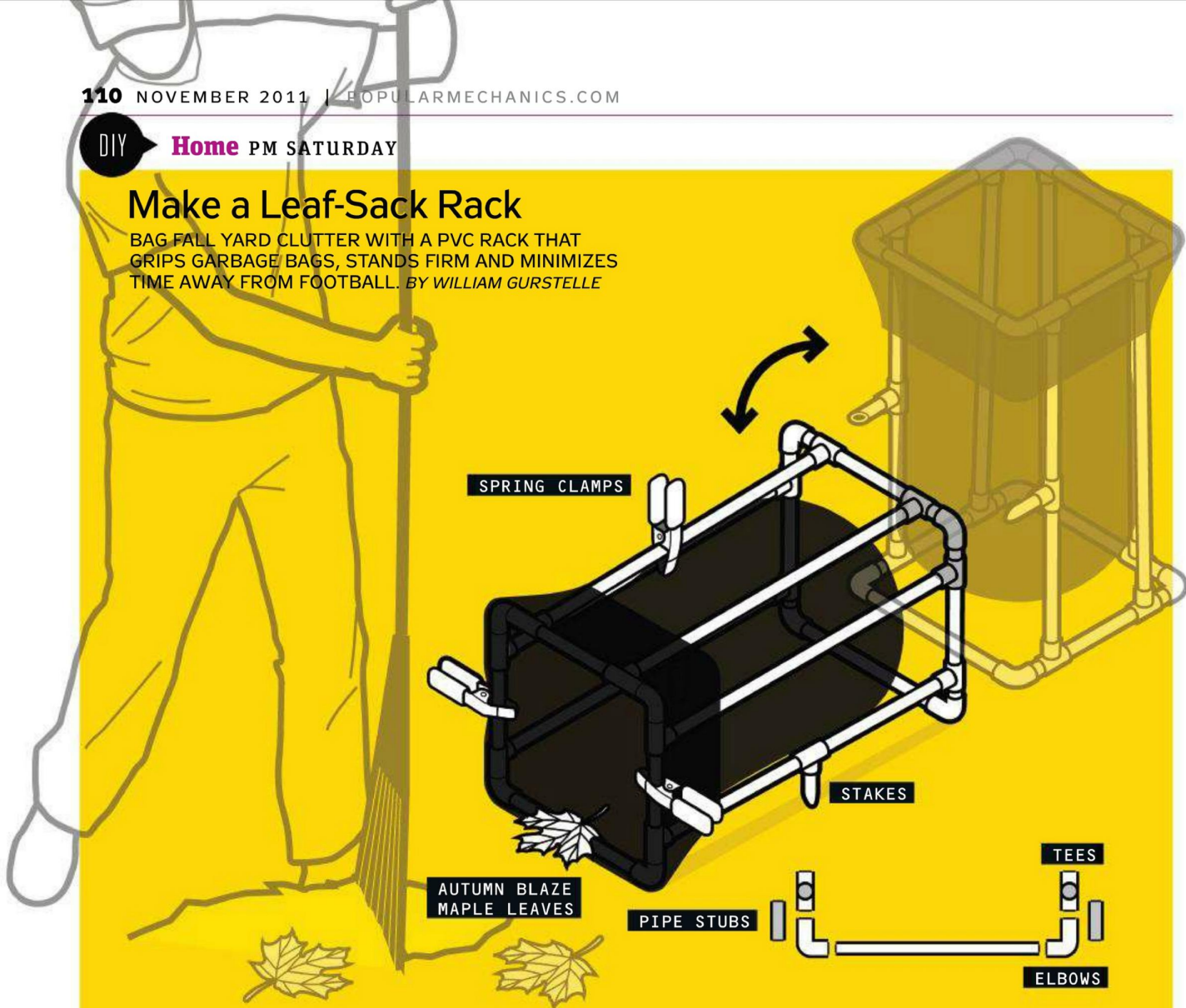


DIY

Home PM SATURDAY

Make a Leaf-Sack Rack

BAG FALL YARD CLUTTER WITH A PVC RACK THAT GRIPS GARBAGE BAGS, STANDS FIRM AND MINIMIZES TIME AWAY FROM FOOTBALL. BY WILLIAM GURSTELLE



1 → PLAN YOUR ATTACK

If you can't burn, mulch or compost leaves, the only option is to bag 'em—a laborious task. To make the chore easier, build a sack rack using 27 feet of $\frac{3}{4}$ -inch PVC pipe, eight $\frac{3}{4}$ -inch elbows and 14 $\frac{3}{4}$ -inch tees. The bottom end anchors a tapered rectangular prism. Spring clamps hold open a 39-gallon bag. Tip it over and stakes keep the rack steady for raking.

2 → MAKE PIPE SQUARES

The frame contains two square ends connected by 36-inch-long upright supports on three sides. Fit six tees on the ends of three 9-inch pipes. For the top square, use $1\frac{1}{2}$ -inch stubs to join the tees to four elbows. Fit a 15-inch pipe between the elbows to finish the square. To make the bottom square, repeat the process above, but use 3-inch stubs. Connect the elbows with an 18-inch pipe.

3 → CONNECT THE ENDS

To make six uprights, cut four lengths of PVC to 36 inches. Prepare each of two staked uprights by fitting a tee between two pipes, creating two assemblies 36 inches long. Connect the six uprights to the top and bottom squares by inserting them into openings on the squares' 12 tees. Because the bottom square is larger than the top one, the uprights cant 5 degrees from vertical.

4 → RAKE AND BAG

Make two stakes by cutting one end of two 4-inch-long pipes at an angle. Insert the square ends into two open tees at the uprights' midpoints. Face the stakes toward the side of the rack with no upright. That side is open to ease removal of a full bag. Fit a bag opening around the small square, tip over the rack, and press the stakes into the ground. Clamp the bag and rake in leaves.

+ MORE TO DO IN NOVEMBER

Stow the Mower

→ Matt Scherbring of Iowa's Monticello Equipment Company says to add stabilizer to a mower fuel tank. Run the mower and put it away. "Nine times out of 10, it'll start right up in the spring," he says.

Ride the Slickrock

→ Join hundreds of off-road enthusiasts in the Moapa Valley, home of the 31st annual Hump-N-Bump. Ride dunes, climb rocks, and cruise in the desert outside Logandale, Nev., Nov. 4 through 5.

Prep a Bike for Winter

→ Cold-weather biking requires a heavier chain lubricant to handle salt, grit and grime. Henry Carter of Brooklyn's 9th Street Cycles recommends Finish Line's WET Lubricant and switching to knobby tires.

Trade Up on Your RV

→ Find deals on recreational vehicle parts at the A-1 Swap Meet in New Lothrop, Mich., Nov. 4 and 5. With 350 swappers, "it's humongous," organizer Dianna Miller says. "It's not junk."

Brace the Bathroom

→ Head off awkward moments this Thanksgiving by prepping guest privies: Tighten toilet seat screws, check flapper valves and flushing hardware, provide a plunger, and stock up on soap.

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How to Inspect a Used Car

DO YOUR DUE DILIGENCE AND YOU'LL REDUCE YOUR CHANCES OF GETTING BURNED BY A SECONDHAND CAR. BY LARRY WEBSTER

➔ **Sooner or later most of us will buy a used car.** Whether it's a cheap set of wheels for a teenage driver, a classic muscle car, a well-worn 4x4 just for winter or simply a low-mileage alternative to a new car, the possibilities are endless. The trick to buying any previously owned car is to know what you're getting. And in the wild world of used cars, the only way to set your mind at ease before you buy is a thorough inspection. Sure, you can farm this out to an expert, but anyone with some mechanical experience can perform the task. You'll save a few bucks and add to your automotive knowledge. We're here to show you how to navigate your way through a sea of possible lemons.

With the help of two certified mechanics, we've produced a 101-point used-car checklist that you can tear out of the magazine or download from popularmechanics.com/usedcarchecklist.

INSIDE ✕ OXYGEN SENSORS + ROTTEN EGGS + MYSTERY LIGHTS

THE ART OF THE INSPECTION

Before you do anything, check for an online community focused on the model you're going to inspect. Many cars, especially enthusiast favorites, have well-known trouble spots.

When you arrive on location, ask to see the car's title. Salvaged cars, ones that were totaled and fixed or flooded, have the word "salvage" on the title. (Unless the price is ridiculously low, treat salvaged cars like they're on fire: Run.) Also ask for service receipts. A thorough service history indicates a properly maintained car and verifies the car's mileage. (In addition, try to obtain a report from Carfax or AutoCheck.)

Assuming the paperwork checks out, examine the car outside—natural light reveals more flaws. On vehicles from 1996 onward, use a scan tool—either rent one or equip a smartphone with the \$99 GoPoint GL1 cable and app—to record any fault codes (an Internet search will reveal their meaning). Check for rusty areas and dented, crinkled or shiny metal. Rust is an obvious problem, but gouges along the underbody pinch welds suggest that the car has been on a frame-straightening machine. Small crash fixes don't necessarily fail a car, but you don't want a vehicle that took a huge hit. Note any fluid leaks or puddles under the car. Fixing leaks can be easy and cheap, like replacing a valve-cover gasket, or in the case of a bad rear-main seal, complicated and expensive.

In the engine bay, check that all the fluid levels are within range. Note anything amiss, like bare, stray wires. Engines in modern cars are quite robust, provided they've been maintained. But it's a good idea to remove the dipstick and wipe it

on a clean white rag. The oil should be brown. Milky oil suggests coolant in the sump; a gas smell means worn piston rings. And if there are fine metallic particles mixed with the oil, the engine won't be running for long. Do the same fluid check for the transmission. Dark or metallic particles indicate worn parts.

Make sure you get behind the wheel. Steve Steeb, owner of Steve Steeb Service in Ann Arbor, Mich., relies mostly on the test drive to suss out a car's condition. Steeb drives on varied roads—some with bumps, others long and straight—and listens for any strange noises. He applies brakes during turns and drives up steep parking lot ramps. He's not looking for specific flaws ("Worn brakes are easily fixed," he says), but rather, getting the general feel of the vehicle. Several things will immediately fail a car—a knocking noise from the engine, jerky transmission shifts, a slipping clutch or banging from the suspension—but Steeb is also trying to decide if it simply feels worn out. "Little things add up," he says. "Does the steering wheel jiggle, or does the car pull to one side when braking. Is the interior a cacophony of rattles? I tell folks to trust their intuition."

A few warts don't mean that a used car is a bad buy. Take a survey of the numerous online price guides and use that book value as a starting point. Employ the demerits you've compiled to negotiate. With any used car, expect the unexpected. "There's a lightning strike waiting in every older car," Steeb says. So leave a little in the budget to cover the inevitable unforeseen repair. But if you're detailed and diligent, you can minimize your chances of ending up with a clunker. **PM**

WHAT TO WATCH OUT FOR

Any inspection checklist aims to help you, the buyer, eyeball the car completely. Often there isn't one obvious tell that the car is a basket case, but rather, several little things that, taken together, become revealing. Be thorough.

NOTED, BUT NOT SERIOUS



NO. 20: SEAT TEARS Unless the car is nearly new, expect some blemishes. Higher-mileage cars typically have wear marks in the interior, like torn driver-side bolsters.

SERIOUS ISSUE



NO. 40: FLUID LEAKS It's hard to predict when a slow leak will turn major, and the cost to fix varies widely. Assume the worst.

CAUSE FOR CONCERN



NO. 13: THE MAGNET TEST Put a magnet on the sheet metal (use a rag to avoid marring the finish). If it fails to stick, there's a thick layer of filler under the paint from shoddy dent repair.

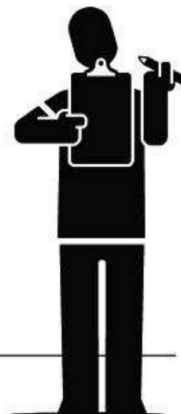
DEAL BREAKER



NO. 62: OIL SEASONED WITH METAL FLAKES Shiny particles in the oil mean the engine is tearing itself up. DEFCON 1.

HOW TO USE THE CHECKLIST

Mark your answers and then tally the totals for each category. Use the scorecard at the end as a guide to determine the car's overall condition.



USED-CAR CHECKLIST

Popular Mechanics

TOOLS TO BRING



Flashlight



Jack



Jackstands



Code reader



Clean, white rags



Magnet

MAKE

MILEAGE

MODEL

VIN

YEAR

ASKING PRICE

SCAN-TOOL CODES (IF ANY)

KEY



Noted, but not serious



Cause for concern



Serious issue

DEAL BREAKER

Flee the premises.

THE BASICS

	Yes	No
1 Is the owner's manual missing?	☐	☐
2 Are there large gaps in the service history or no records at all?	☐	☐
3 Do you suspect the mileage isn't legitimate?	☐	☐
DEAL BREAKER		
4 Does the title include the word "salvage"?	☐	☐

EXTERIOR

5 Is there evidence of curb damage on the wheels?	☐	☐
6 Are the windshield wiper blades damaged?	☐	☐
7 Are any hubcaps missing, damaged or loose?	☐	☐
8 Are all the tire pressures properly set?	☐	☐
9 Is the paint faded or cracked?	☐	☐
10 Are any panels a different shade or color?	☐	☐
11 Are any of the panel gaps markedly different than the others?	☐	☐
12 Are any of the trim pieces loose or missing?	☐	☐
13 Does a magnet fail to adhere to the sheet metal? (Try several spots.)	☐	☐
14 Are any of the tires a different brand or size?	☐	☐
15 Is there evidence of accident damage that has been poorly repaired?	☐	☐
16 Are lug nuts missing?	☐	☐
17 Are there any small dark spots or oily film on the bumper near the exhaust pipe?	☐	☐
18 Are there any small rust spots?	☐	☐
DEAL BREAKER		
19 Is there rust everywhere?	☐	☐

INTERIOR

20 Are there any tears or wear marks in the seats?	☐	☐
21 Are there any cracks, blemishes or broken trim?	☐	☐
22 Are the spare tire, jack and tools damaged or missing?	☐	☐
23 Do any of the windows go down or up slower than the others? Do they make noises?	☐	☐

	Yes	No
24 When the climate control is turned on, does the fan squeak or rattle or operate on only one speed setting?	☐	☐
25 Does the air conditioning blow warm air?	☐	☐
26 Turn on all the accessories (windshield wipers, radio, power mirrors, etc.). Do any fail to operate properly?	☐	☐
27 Is the brake pedal worn more or less than the mileage on the odometer would suggest?	☐	☐
28 Is there any rust or evidence of water in the spare-tire well?	☐	☐
29 Does the sunroof operate slowly, as if it's struggling to move?	☐	☐
DEAL BREAKER		
30 Is there a stale smell, like mildew or spoiled milk?	☐	☐
31 Is there evidence of water damage in the glovebox or under the rear seat?	☐	☐

CHASSIS/UNDERBODY

32 Are any of the inner fender shields missing or broken?	☐	☐
33 Put your knee on the bumper, bounce the car three times, then stop. Does the body move up and down more than two times?	☐	☐
34 Is there uneven wear on any of the tires?	☐	☐
35 Does oil coat any of the shock absorbers?	☐	☐
36 Jack up the car and safely support it so the wheels are off the ground. Tug and push on the wheels. Is there any lateral play at the hub?	☐	☐
37 Pull on the tie rods and the suspension mounts. Do you detect any movement?	☐	☐
38 Are the brake pads and rotors worn out?	☐	☐
39 Is there rust on any of the underbody surfaces?	☐	☐
40 Check the engine bottom. Any sign of fluid leaks?	☐	☐
41 What about transmission and differential leaks?	☐	☐
42 Is there any bent or dented metal?	☐	☐
43 Are there shiny marks on the pinch welds?	☐	☐
44 Is there fluid seepage around the brake caliper or from the bottom of the brake drums?	☐	☐
45 Check the ground under the car. Are there any puddles of oil or fluid?	☐	☐
46 Look at the bottom of the radiator. Is it wet from coolant?	☐	☐

USED-CAR CHECKLIST

Popular Mechanics

ENGINE

	Yes	No
47 With the engine off, squeeze the hoses (be careful, they may be hot). Do they feel stiff or brittle?	☐	☐
48 Are there cracks in the belt(s)?	☐	☐
49 Are there any wires not covered by sheathing?	☐	☐
50 Are there any loose hose clamps?	☐	☐
51 Are there any loose and corroded battery clamps?	☐	☐
52 Is the battery more than 4 years old?	☐	☐
53 Is there any sign of fluid leaks at the accessories (power-steering pump, brake reservoir)?	☐	☐
54 Any evidence of nesting mice or other animals?	☐	☐
55 Is the air filter dirty?	☐	☐
56 Are fluid levels (power steering, brake, coolant, oil and transmission) below the minimum?	☐	☐
57 Check for oil change stickers. Is the car long overdue?	☐	☐
58 Is there seepage at the bottom of the brake reservoir?	☐	☐
59 Is there sludge in the bottom of the coolant reservoir?	☐	☐
60 If the engine has a timing belt, is it older than 4 years? If unknown, answer "yes."	☐	☐

DEAL BREAKER

61 Put a drop of oil from the dipstick on a clean, dry rag. Does it appear gooey or black?	☐	☐
62 Are there shiny metallic particles in the oil?	☐	☐
63 Does the oil look milky or smell like gasoline?	☐	☐
64 Remove the oil filler cap. Are there thick, black deposits in the cylinder head?	☐	☐
65 Sniff the automatic transmission fluid dipstick. Does it smell burnt?	☐	☐
66 Wipe the dipstick on a clean, white rag. Are there a lot of black particles, or is the fluid dark?	☐	☐

ENGINE, ADVANCED

(REQUIRES A MORE RIGOROUS INSPECTION; CLEAR WITH OWNER FIRST)

67 Check the battery for parasitic drains. Is the standby current more than 75 milliamps?	☐	☐
68 Check the voltage between the coolant and battery ground. Is it higher than 250 millivolts?	☐	☐
69 Plug in a scan tool. Are there any pending codes?	☐	☐
70 Pressure-test the cooling system. Does it leak?	☐	☐

DEAL BREAKER

71 Do a compression test. Are any of the cylinders 25 percent lower or more than the highest?	☐	☐
72 Do a cylinder leak-down test. Do any cylinders leak more than 15 percent?	☐	☐

POWERTRAIN STARTUP

73 Are there any strange noises (belt squeak, exhaust leak)?	☐	☐
74 Turn the key to the "on" position. Do the warning lights fail to illuminate?	☐	☐
75 Start the car. Do the warning lights remain on?	☐	☐
76 Does the airbag light stay on or blink?	☐	☐
77 Does the engine fail to settle into a consistent idle within a couple of minutes?	☐	☐
78 Automatic transmission: Put the car in drive. Does it clunk into gear?	☐	☐
79 Manual transmission: Depress the clutch. Does it feel stiff or jerky?	☐	☐

ON THE ROAD

	Yes	No
80 Drive the car in tight circles in a parking lot. Does anything rub or clunk?	☐	☐
81 Brake firmly. Does the pedal feel soft and mushy?	☐	☐
82 Does the feel of the brake pedal change (e.g., soft one stop, firm the next)?	☐	☐
83 Does the car veer to one side while braking?	☐	☐
84 Drive over some bumps at normal speeds. Does the car bounce up and down after hitting a bump?	☐	☐
85 Do you hear any loud noises from the suspension, such as clunks or creaks?	☐	☐
86 Get up to highway speeds. Is there any vibration?	☐	☐
87 Is the steering wheel off-center when the car is going straight?	☐	☐
88 Do you hear excessive wind noise?	☐	☐
89 Do the interior pieces rattle over bumps?	☐	☐
90 Does the car pull to one side?	☐	☐
91 Accelerate briskly. Does the transmission jerk at the shift points?	☐	☐
92 Does the car accelerate in fits and starts?	☐	☐
93 Manual transmission: Put the car in top gear while driving at 30 mph. Floor the throttle. Do the engine revs climb quickly, as if the clutch is slipping?	☐	☐

DEAL BREAKER

94 Do you hear any knocking noises from the engine that get faster with higher engine speed?	☐	☐
95 Does the car feel tired, as if it's worn out?	☐	☐

TEST DRIVE (WITH A FRIEND)

96 Have someone watch the headlamps and marker and brake lights as you operate them. Are any burned out?	☐	☐
97 With your friend standing behind the car, start the engine. Is there sustained visible smoke?	☐	☐
98 With your friend following, drive the car. Do the wheels wobble, or does the vehicle have an odd stance (e.g., it rides low in the rear)?	☐	☐
99 Is there smoke coming from the exhaust during acceleration?	☐	☐

POST-TEST-DRIVE INSPECTION

100 Look under the hood. Do you hear a hissing noise?	☐	☐
101 Check under the car again. Any sign of fresh fluid leaks?	☐	☐

WHAT IT MEANS

Number of "yes" answers	Conclusion
Fewer than 5	<i>Probably a cream puff</i>
5 to 10	<i>Relatively easy to fix</i>
More than 10	<i>Potentially a time sink, but nothing serious</i>
Fewer than 5	<i>Nothing to fret about—it's a used car</i>
5 to 10	<i>Enough DIY fix-its to last a year</i>
More than 10	<i>Just walk away</i>
Fewer than 3	<i>Make a lowball offer</i>
3 to 6	<i>Proceed with extreme caution</i>
More than 6	<i>Abandon all hope, ye who enter here</i>

DEAL BREAKER

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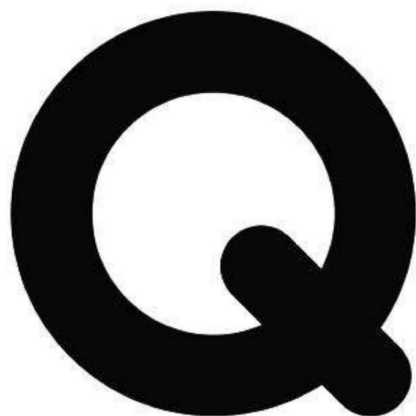
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Car Clinic

by Ben Wojdyla

Q+A



Oxygen Deprivation

I've got a 1998 Ford Taurus, and the Check Engine light came on. Checking the code with an OBD-II scanner revealed a bad oxygen sensor. What's the best way to replace it?

A Your car's computer uses data from the O₂ sensors to determine the effectiveness of the catalytic converter and how much fuel to inject. So they're critical pieces. Luckily, replacing one is relatively straightforward. Unfortunately, original-equipment oxygen sensors, offered by the manufacturer, can be pricey. The solution is

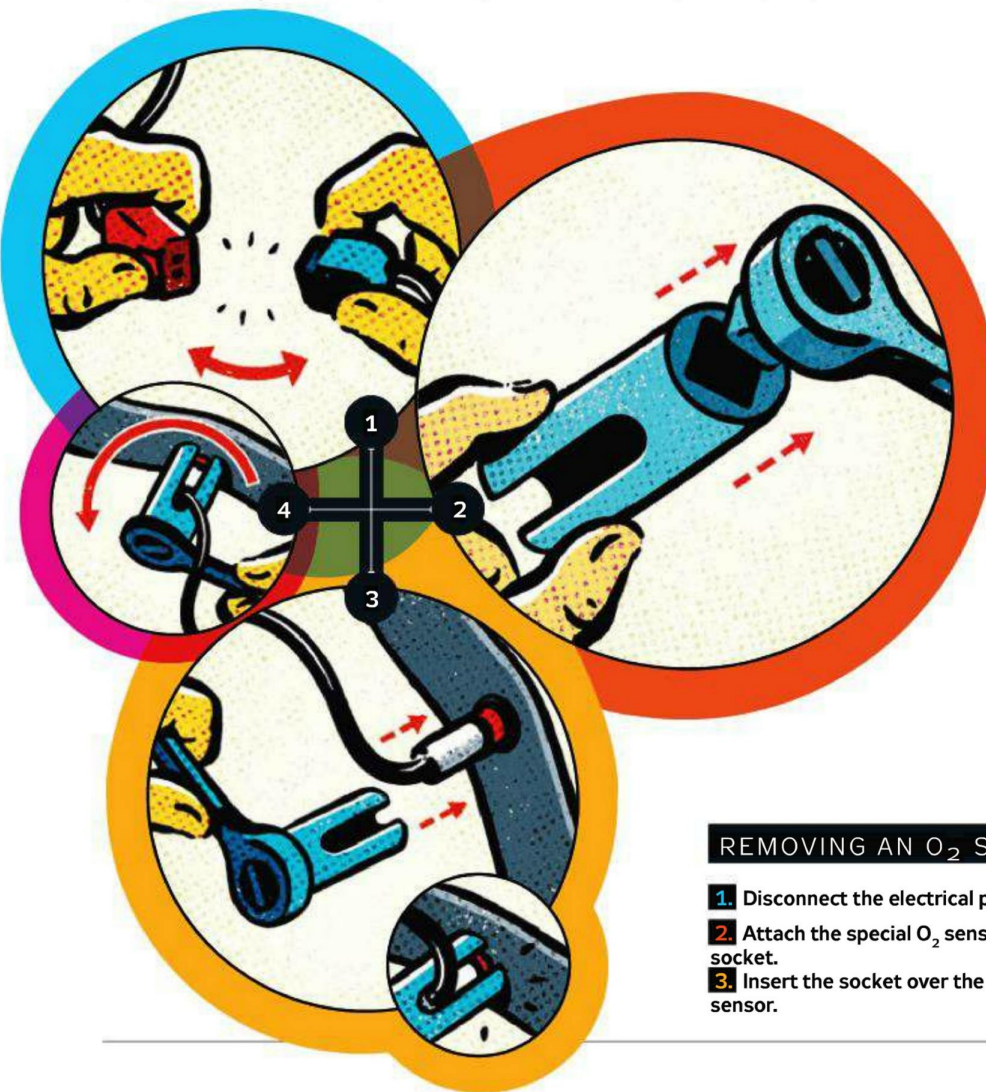
to buy a cheaper, universal-replacement sensor from your local auto parts store.

Ah, but all sensors are not the same. Older cars typically used basic units with just one wire (the wire carried the signal, while the unit simply grounded to the exhaust pipe). Newer cars are fitted with heated O₂ sensors with up to four wires, allowing the sensor to reach its base 250 F operating temperature more quickly. The most surefire way to buy the right replacement is to first remove the bad one and take it with you to the store.

The sensor is typically almost welded to the exhaust, so apply a liberal spray of penetrating oil to the threads of the sensor and let it loosen the joint. Unplug the sensor from the wiring harness, and get a special O₂ sensor socket from the auto parts store (some loan them out for free) and remove the old sensor from the exhaust bung. If the sensor won't budge, try more penetrating oil or attempt the removal with the engine warm (be careful not to burn yourself).

The universal replacement may come with an adapter plug to mate the new sensor to the car's wiring harness. If so, use the adapter. Never cut the wires on O₂ sensors that come with adapters, because, interestingly, these types of sensors "breathe" through the wires. Every O₂ sensor works by comparing exhaust gas to outside air—the difference in oxygen levels creates a voltage that's read by the car's computer. As a result, cutting the wires and soldering them clogs that minute pathway and renders the sensor useless.

There are, however, some sensors that sample outside air near the unit's base and therefore come with just bare wires. If you obtain one of these, you'll need to cut the plug off the old sensor and splice it to the new one. Strip the



REMOVING AN O₂ SENSOR

- 1.** Disconnect the electrical plug.
- 2.** Attach the special O₂ sensor socket.
- 3.** Insert the socket over the sensor.
- 4.** Turn counterclockwise to remove it, while being careful not to damage the wires.

ILLUSTRATION BY CHRIS GASH



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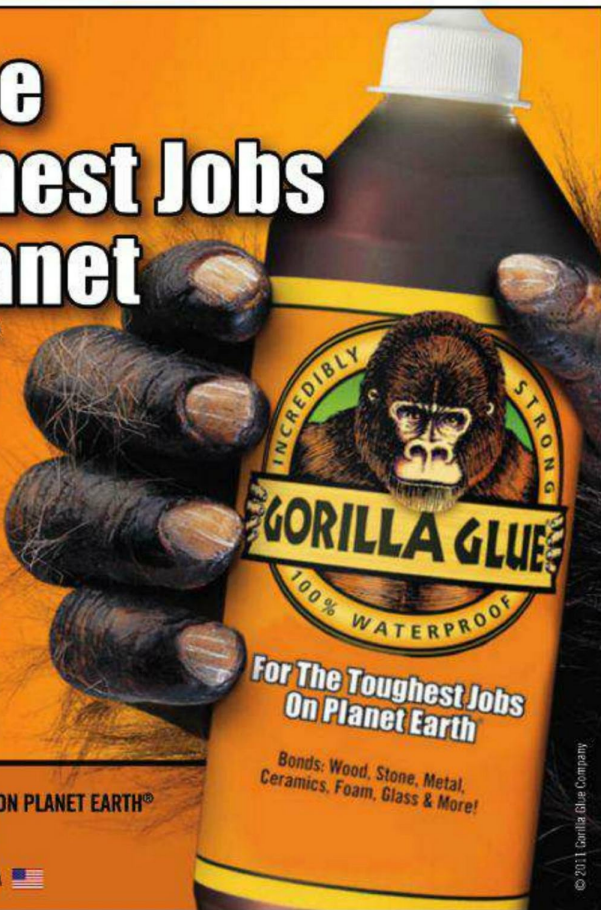
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insulation off the ends, slide sections of heat-shrink tubing over the sensor wires, and splice the joint together with solder. Finish by applying heat, sealing the joint.

Your new O₂ sensor should be handled like a piece of china. Do not allow the tip to touch anything—it may become contaminated. Apply a small amount of anti-seize to the threads and hand-tighten the sensor in the exhaust bung, being careful to keep the tip away from the sides. Use the sensor socket to tighten the O₂ sensor to three-quarters turn past finger-tight, depending on the manufacturer's recommendation. Finally, reroute the wire and attach the connector. Be sure to keep the wire from direct contact with high-heat sources.

Hot-Tempered ☺ I have a 1994 Mazda Miata, and when the engine is hot, it either cranks very slowly or not at all. I replaced the starter about a year ago, but this problem is new. The voltage at the starter is fine, but it's still not cranking fast enough. What's wrong?

In all likelihood, you've gotten yourself a bad starter. Yeah, it happens—even new parts are sometimes toast, right out of the box. There used to be shops that rebuilt starters, but they're rare these days, so it's tough to know if the problem is the starter bushings or the windings. But before you remove the starter, check a few other things first. Assuming your battery is healthy, verify the starter relay (usually in the engine bay) is functioning properly. Its job is to use the low-voltage signal from the ignition switch to release the high-amperage power needed to run the starter. Test the switch after the engine is hot by applying 12 volts to the switch side (small wires); if you don't hear an audible click or the starter engage, the relay is dead. Also be sure to

inspect all of the ground wires that connect the engine to the chassis to make certain power is flowing. If nothing seems troublesome, remove the starter and take it to your auto parts store for a free test. Keep in mind, however, that your starter misbehaves when it's hot, so your best bet is simply to try a new one.

Rotten Eggs 🥚 Recently my 1973 MGB has been emitting a foul, rotten-egg smell that makes the cabin unbearable. What is making my car so stinky?

Typically, the sulfur odor is an indication of a bad catalytic converter. But not only was your vintage ride built without a cat, it's also British, which means the electrical system is the prime suspect in any problem scenario. First, check the battery and charging system. While the car is running, check the voltage at the battery leads. The reading should be about 14 volts. If it's higher, say, 16 or 17, then the alternator is overcharging the battery, which breaks down the sulfuric acid electrolyte, causing the battery to stink. Most likely you need a new alternator, which comes with a fresh voltage regulator. Check the battery as well. It's probably cooked.

Mystery Light 🌟 I own a 1998 Dodge Neon Sport. The other day I had the local Sam's Club install a new battery. Since then, the Check Engine light has remained on. I checked my Chilton's manual, and it seems the computer displays a trouble code when the battery has been disconnected. Is there any way I can clear this trouble code without buying a \$100 OBD-II tool?

Something's screwy here. There is no code for a disconnected battery that will turn on the light. In fact, one way to clear a trouble code from the computer's memory is to disconnect the battery for a minute. But wait! If there's no problem, any code will eventually clear itself and the light will go out. So try disconnecting the battery, or at least pull the computer's fuse for 30 seconds. If the light is still on, you'll need to beg, borrow or rent a scan tool or code-scout to suss out the issue. Hint: Most auto parts stores will loan you a scan tool for free. Just plug into the car's OBD-II port in their parking lot, get the code and reset the light.

Pickup Pointer 🚚 Does driving with the tailgate down on a pickup result in better gas mileage?

Nope. Our pals the MythBusters tested pickup fuel economy twice and found leaving the tailgate up uses less fuel. The duo tried other configurations, including a rigid tonneau cover and a nylon net in place of the tailgate. The best setup was the mesh. The worst: leaving the tailgate down. **PM**

Got a car problem?

Ask Ben about it. Send your questions to pmautoclinic@hearth.com or over Twitter at twitter.com/PopMechAuto or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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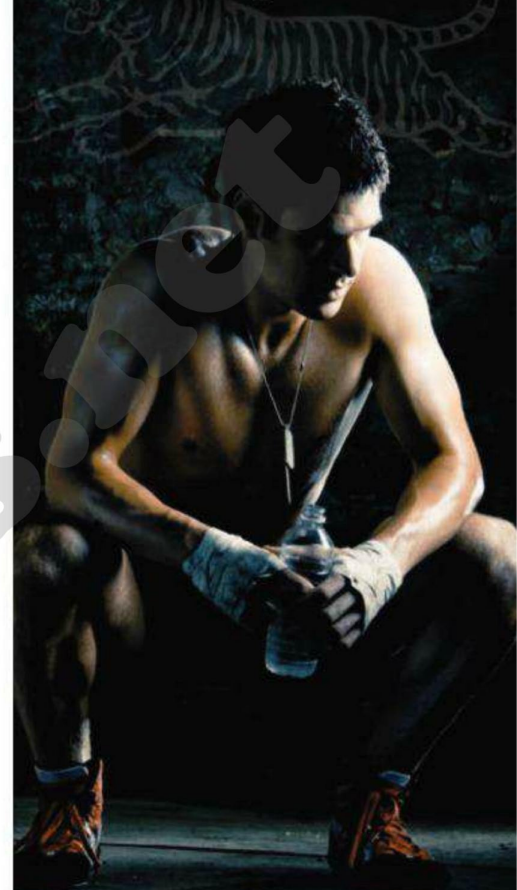
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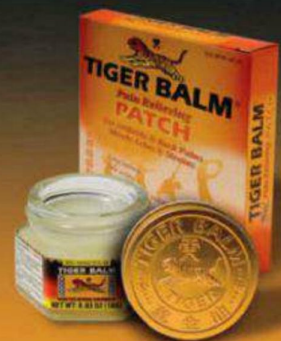
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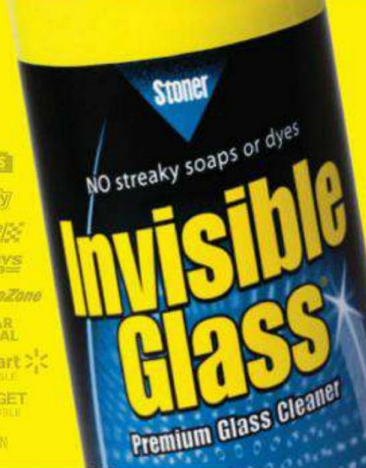
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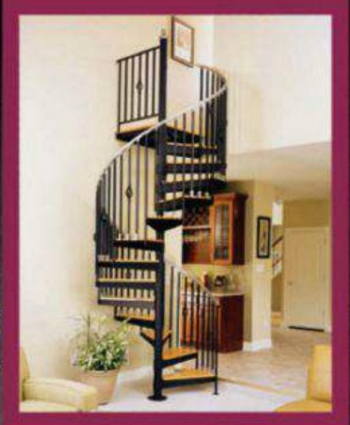


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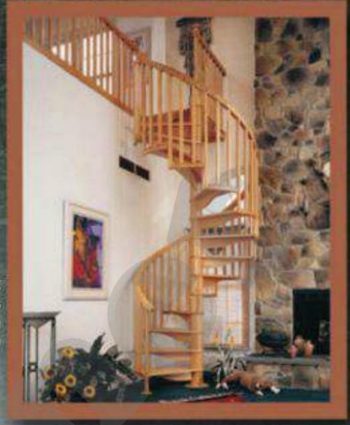
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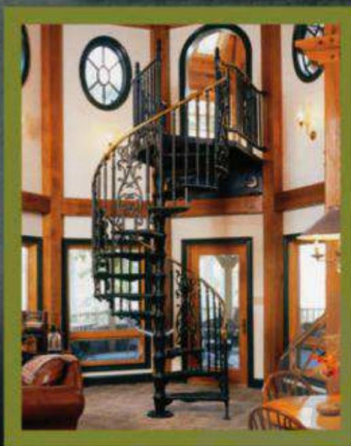
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HOW IT WORKS

→ The ascender—first covered by *POPULAR MECHANICS* in September 2010—handles rope similarly to a capstan, which raises and lowers anchors: Its grip tightens as more weight is added. After the operator wraps a loop around the machine's rope-grabbing spindle, he clips his harness to the ascender, engaging the rope with the battery-powered mechanism. As the spindle turns, the ascender climbs. The rope is typically pre-secured in place above the operator. But the device can also be equipped with a grappling hook and shot from the ground to an anchor for use in extreme situations. "It's very much like Batman," Ball says.

WHAT IT CAN DO

→ The latest version of the ascender (APA-5) weighs 15 pounds and can lift 500 pounds up to 700 feet on a single battery charge and hoist a person up a five-story building in 10 seconds. Special models can rocket at 10 feet per second. "It's a huge thrill," Ball says, "but you have to be focused and ready to avoid obstacles at that speed."

APPLICATIONS

→ The power-tool-size device allows people to scale cliffs, buildings and oil rigs; explore caves; inspect shipping containers; and perform rescue operations. Next up for the APA: helicopter rescue. "With the ascender, any helicopter could be used for rescue, even a news chopper," Ball says. In a recent test, his ascender hoisted a team of Marines into a CH-46 helicopter hovering 100 feet above the ground.

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✖ **Nate Ball spent his childhood** tinkering in the backyard. "I grew up without TV, so I spent all my time being creative and making stuff," he says. That came in handy when he entered the 2005 Soldier Design Competition as a mechanical engineering student at MIT. The team's challenge: Create a device that would allow a person to scale a structure quickly. Today, their invention—the Atlas Power Ascender—is used by the military and government agencies to climb mountains, buildings and ships around the world. Ball is passionate about encouraging children to pursue an interest in science and engineering—and the ascender helps him do that. "It's a huge kick to see their faces when you pull the trigger and jump off the ground for the first time," he says. "They see that engineering can be cool." — DOUGLAS MAIN

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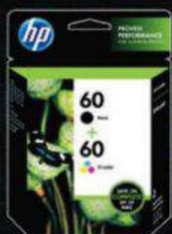
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